Fosters

ARITHMETICK:

1686
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OR, THAT

Useful ART

Made Easie.

Explaining the *Grounds* and *Principles* thereof, both in whole Numbers and Fractions.

By such *Plain*, *Easie*, and Familiar Rules and Precepts, that any Person of a Reasonable Capacity, may (in a short time) attain to a Competent Proficiency therein, without the help of any Tutor.

Newly Corrected, and much Enlarged

By *HENRY COLE*

Teacher of the *Mathematicks*.

LONDON:

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TO ALL

Merchants, Factors, Accomptants and others, desirous of Knowledge in the Useful ART of ARITHMETICK.

THis Treatise *I here present to your View, is Principal intended for the Instruction of such as are desirous to attain to a Perfection of Knowledge in the Art of* Arithmetick: *The chief Scope and design hereof being to lay down the whole Rules of the said Art, in so plain and easie a Method, that any one of a reasonable Capacity may soon comprehend them: And all who have not the convenience of a Master or Tutor, may hereby alone attain a competent perfection therein, without the Aid or Assistance of any to instruct them. The Method observed in the Composure, is a gra-*

dual proceeding Step by Step, and from Rule to Rule, as they ought to be read and practiſed, beginning with Numeration, *in which there are more than ordinary Tables fitted for the true and eaſie numbering of many Figures together* --- Addition, *and that is furniſhed with Examples both of* Coyn, Weights, Meaſures, Time, *&c. and ſo is* Subſtraction *alſo* --- Multiplication *is as in others onely here and there are neceſſary* Compendiums *added* --- *And in* Diviſion *(which is the moſt difficult of all the Species) there are different wayes of working that* Rule, *ſo that any perſon may uſe that which he beſt apprehendeth or likeeth.*

Having finiſhed theſe four Primary or (indeed) fundamental parts of Arithmetick, *I proceed next to* Reduction *where (as in* Addition*) there are Examples alſo of* Money, Weights, Meaſures, *and* Time, *and from thence to the* Golden-Rule of Three Numbers, *both* Direct

Direct *and* Retrograde; *all hitherto being performed in* Whole Numbers *only.*

After this, I proceed to Fractions, *beginning with* Numeration, Multiplication, Diviſion, Reduction, Addition, *and* Subſtraction, *The reaſon of which Method is, becauſe* Fractions *may be* Multiplied *and* Divided *without* Reducing, *but they cannot be* Added *or* Subſtracted, *but they muſt firſt be* Reduced.

The Ordinary, general, and moſt uſeful Rules, *being hitherto explained, both in* Whole Numbers *and* Fractions, *I proceed to thoſe of more particular concern to* Merchants, Factors, Tradeſmen, *and the like; and ſuch are* Rules of Practice, The Double Rule of Three, Company *or* Fellowſhip, *with, or without,* Time, Exchange, Barter, Alligation, *and the like. All which, every Rule in the directions thereunto belonging, do ſufficiently explain and demonſtrate.*

Lastly, The Course and Method being observed, the young Practitioner may in a short time attain to such a competent proficiency in this Art of Vulgar Arithmetick, *so far forth as to make him capable of any employment in way of Trade, or Merchandise; for such I write it, and to such I recommend it, wishing them good Success in all their honest Endeavours and Practices, and so I bid them*

Farewel.

OF ARITHMETICK.

Arithmetick is the Art of Numbring well, to the attaining whereof belongeth the knowledge of *Figures*, which are in number *Nine*, to which is added an [o] which makes *Ten*. Of which nine Figures, and the [o] (called a Cypher,) all other Numbers, how great soever, are compounded.

A *nul* or *cypher* in *Arithmetick*, is said to be the *Beginning* of *Number*, in the same sense as a point is of *magnitude*, or lines, *&c.* Hence a *null* is *number* and *unity* denied to be so taken. *Euclid. lib. 7. Def. 1. 2.*

The reason given is, a *null* is *indivisible*, and so is a *cypher*, yet *unity* or an *unite* is allowed to be the beginning of *multitude*, and *multitude* the collection of *unites*.

Of *Numbers* there are three sorts.

1. *Digit Numbers*, which are all Numbers under *Ten*.

2. *Article Numbers*, which are all Num-

bers that consist of any one *digit*, *number*, and a *Cypher*, as *Ten*, *Twenty*, *Thirty*, &c.

3. *Compound Numbers*, which are any number of Figures alone, or with Cyphers and Figures mixed together, as *Seven hundred eighty four*, which consists of three Digit Numbers put together, or *Three hundred and seven*, which consists of two Digits and a Cypher intermixed.

Having declared unto you what Number is, I will now shew you the Characters and places of the Nine Figures, and the Cypher before-mentioned, which is the Office of *Numeration*, which is the first part, or rather the first step to *Arithmetick*.

CHAP.

CHAP. I.

Of NUMERATION.

NUmeration is that part of Arithmetick which teacheth how to read any ſumm of Figures that is written down, or to write down any ſumm that ſhall be deſired: to the attaining whereof, it is neceſſary firſt to know the Names and Characters of the Figures, which are as followeth,

One Two Three Four Five Six Seven
1 2 3 4 5 6 7
Eight Nine Cypher.
8 9 0

And here note, That the Cypher it ſelf ſignifieth nothing, but being adjoined with any other Figure or Figures, it augmenteth or maketh up the place of that Figure or Figures, ten times; or if there be added two Cyphers, it augmenteth the Figure or Figures an hundred times, as the Figure 2 ſtanding alone ſignifieth only *two*, and is ſo called; but if to it you adjoin a Cypher thus, 20, it maketh the *two* ten times two, that is, *twenty*, and muſt be ſo called. But again,

if to the fore-mentioned *two*, you adjoin two Cyphers thus, 200, it augmenteth the *two* an hundred times, that is, it maketh it *two hundred*, and muſt be ſo called.

Note, That what is here ſaid of the Figure *two*, is to be underſtood of any other Figure, as the following Table plainly expreſſeth.

Firſt place, or place of unites.	Second place, or place of tens.	Third place, or place of hundreds.
1 one	10 ten	100 one hundred
2 two	20 twenty	200 two hundred
3 three	30 thirty	300 three hundred
4 four	40 forty	400 four hundred
5 five	50 fifty	500 five hundred
6 ſix	60 ſixty	600 ſix hundred
7 ſeven	70 ſeventy	700 ſeven hundred
8 eight	80 eighty	800 eight hundred
9 nine	90 ninety	900 nine hundred

By this Table you may plainly ſee, that the Figure of 1, ſtanding alone in the firſt place or place of unites, ſignifieth barely One, and 2 Two, and 3 Three. But 1 ſtanding in the ſecond place, or place of Tens, ſignifieth Ten, and 2 Twenty, and 3 Thirty. And *one*, *two*, or *three* ſtanding in the third place or place of Hundreds, ſignifieth 100 or

Hundred

Hundred, 200 two Hundred, 300 three Hundred, &c.

Again, if to *one*, *two*, or *three*, you add three Cyphers, we call that the fourth place, or place of thouſands, and we in that place call one, two, or three [1000] one thouſand, [2000] two thouſand, [3000] three thouſand, and ſo on to what number of places you pleaſe.

So, the fifth place is the place of ten thouſands. The ſixth place is the place of hundred thouſands. The ſeventh place is the place of millions. The eighth place is the place of ten millions. And the ninth place, is the place of an hundred millions, as in the following Table.

Numbers.		Places.
1	one	1
10	ten	2
100	an hundred	3
1000	a thouſand	4
10000	ten thouſand	5
100000	an hundred thouſand	6
1000000	a million	7
10000000	ten millions	8
100000000	an hundred millions	9

Having given you the names and places of the nine Figures, and how they are augmented

mented by the continual adding of Cyphers, I will now ſhew you how to read any great ſumm that ſhall be written down.

Let it be required to read this number of Figures, 763587254. for the ready doing whereof, make a prick with your pen between every third figure, beginning at the right hand, as is here done, 763. 587. 254. theſe pricks divide the great number into ſmaller numbers, namely into 763. 587. and 254.

Now the firſt three Figures towards the left hand, namely, 763, ſtand in the place of Millions, and muſt be called 763 Millions.

The ſecond three Figures, namely, 587, ſtand in the place of thouſands, and muſt be called 587 thouſand.

The three Figures which ſtand next the right hand, ſtand in the place of Hundreds, and muſt be called 254, two hundred fifty four.

And the whole number together is thus to be read, Seven hundred ſixty three Millions, five hundred eighty ſeven thouſand, two hundred fifty four.

And by this distinction may any great sum be easily read, an example whereof you have in this following Table.

3	Three.
27	Twenty seven.
304	Three hundred and four.
3. 461	Three thousand, four hundred sixty one.
40. 572	Forty thousand, five hundred seventy two.
358. 206	Three hundred fifty eight thousand, two hundred and six.
6. 982. 471	6 Millions, 982 thousand, four hundred seventy one.
98. 423. 175.	98 Millions, 423 thousand, one hundred seventy five.
736. 528. 379	Seven hundred thirty six millions, five hundred twenty eight thousand, three hundred seventy nine.

place of millions — place of thousands — place of hundreds

A second Table of Notation, fit to be learn'd by heart.

Names.	Millions,	Thousands,	Units,	
Values.	CXI.	CXI.	CXI.	
Degrees.	987	654	321	Place
Periods.	3	2	1	
	999	999	999	
	888	888	888	
	777	777	777	
	666	666	666	
Integers.	555	555	555	
	444	444	444	
	333	333	333	
	222	222	222	
	111	111	111	

Explanation.

Begin at the right hand, and go back wa saying, or accounting, 9 in the first place 9, nine, 9 in the second place is 90 nine and 9 in the third place is 900. *viz.* ni hundred, 9 in the fourth place is 9000 n thousand, 9 in the fifth place is 90000 nin thousand; and so on, observing the Nam above, their Values, Places, and Periods.

Numeration or *Notation* of number h

four parts, two of Equality, *Addition* and *Subduction*, or *Substraction*, and two of Proportion, *viz. Multiplication* and *Division*; of all which, in Order in the following Chapters.

CHAP. II.

Of ADDITION.

Addition is the collecting or gathering together of divers ſmaller ſumms into one entire or groſs ſumm.

For the performance whereof, this is *The RULE, Let the ſeveral ſmaller ſumms be ſet in order one under another, as Unites under Unites, &c. and underneath them draw a line, then beginning with the lowermoſt figure of the laſt rank (which is that next your right hand) add all the figures in that rank together, then conſider how many Tens the addition of that rank contains, and for every Ten keep one Unite in mind to be carried to the next rank of Figures, and what odd Digits there are, above the Tens, ſet down under that rank beneath the line. Having finiſhed one rank of numbers, proceed to the ſecond, and from that to the third, &c.*

EXAM-

EXAMPLE.

Paid at ſeveral times to ſeveral perſons, the ſumms following.

	lib.	
To Mr. *Green*	937	*Apr.* 7. 1654.
To Mr. *Ward*	772	*Apr.* 16.
To Mr. *Smith*	53	*May* 4.

Set the ſeveral ſumms in order as you ſe in the Example, and draw a line under them then beginning with the laſt rank of Figure which is that towards the right hand, beg with the lowermoſt Figure thereof, which 3, ſaying 3 and 2 is 5, and 7 is 12, ſet 2 u der the line, and carry one Unite to the ne rank of Figures (becauſe there was one T in the addition of that rank) ſaying, One I carried and 5 is 6, and 7 is 13, and 3 is 1 ſet 6 under the line, and carry one Unite the next rank, ſaying in your mind, O which I carried and 7 is 8, and 9 is 17, ſ 7 under the line, and carry one to the next rank; but ſeeing there are no more ranks to carry your Unite to, therefore you muſt ſet it down, and your ſumm will ſtand as here you ſee, The total or groſs ſumm whereof being 1762 *l.* And in this manner may you add as many, or as fe ſumm

lib.
93
77
5
17

ſumms together as ſhall be required, as by the Examples following may appear, which I have only ſet down for young beginners to practice by.

A Table of Addition and Subduction of the 9 Digits, to be learn'd by heart.

0	1	2	3	4	5	6	7	8	9
1	2	3	4	5	6	7	8	9	10
2	3	4	5	6	7	8	9	10	11
3	4	5	6	7	8	9	10	11	12
4	5	6	7	8	9	10	11	12	13
5	6	7	8	9	10	11	12	13	14
6	7	8	9	10	11	12	13	14	15
7	8	9	10	11	12	13	14	15	16
8	9	10	11	12	13	14	15	16	17
9	10	11	12	13	14	15	16	17	18

This Table is plain, and eaſy to be underſtood thus. *Example.*

Suppoſe I would know the ſumm of 9 and 8. I ſeek 9 in the firſt left hand Column, and 8 at top, and then in the common Angle, I find 17, or for ſubſtraction, 8 at top taken from 17, remains 9 in the firſt Column, or 9 from 17, reſts 8 at top, *&c.*

Crowns.

Crowns.	Yards of Cloth.	Barrels of Sope.	Tuns of Wine.
6250	579	5002	57
4621	364	460	84
872	851	200	36
60	963	69	23
In all 11803	26	83	200
Crowns.	14	5814	Tuns.
	8	Barrels.	
	In all 2805	Yards of Cloth.	

Addition *of Numbers of divers denominations.*

By numbers of divers denominations meant ſuch numbers as conſiſt of themſe and their parts, as if the ſumms be of mo then the greateſt denomination is of Pou and the parts of a Pound are Shillings, the parts of a Shilling are Pence, and parts of a Penny are Farthings, which is ſmalleſt of Engliſh money.

Now to perform the work of Additio Numbers of divers denominations, this o is to be obſerved.

The RULE.

Place all Numbers of the ſame denomina-
n, one directly under another, as pounds *un-*
r pounds; ſhillings *under* ſhillings; pence
der pence; *and* farthings *under* farthings.
ben draw a line under them, and begin your
ddition with the leaſt denomination firſt; ob-
rving, how many times the next greater deno-
ination, is contained in the next leſſer; and
r every time carry one unite to the next denomi-
tion, (as before you did the tens) ſetting
wn the remainder, if any be, then adding the
xt denomination together, take notice how many
nes the next greater denomination is contained
that leſſer, carrying for every time one to the
xt denomination greater; thus proceeding till
u have gone over all the denominations, be
ey never ſo many.

Example 1. Let the numbers to be added
: 29 *l.* 16 *ſ.* 8 *d.* 32 *l.*
7 *ſ.* 9 *d.* 81 *l.* 13 *ſ.* 11 *d.*
nd let it be required to find
e total or groſs ſumm.
ere in this Example the
aſt denomination is pence,
herefore I begin with them
nd ſay 11 *d.* and 9 *d.* is 20 *d.* which is
ſ. and 8 *d.* make a prick againſt the 9,
nd ſay, 8 *d.* and 8 *d.* is 16 *d.* that is 1 *ſ.*
4 *d.*

lib.	*ſ.*	*d.*
29	16.	8.
32	17.	9.
81	13	11
144.	8	4

4 *d.* make a prick againſt the 8. and ſe
down the odd 4 *d.* then (becauſe there ar
two pricks in the line of pence) you mu
carry 2 *s.* to the place of ſhillings; ſayin
2 *s.* which I carry and 13 *s.* is 15 *s.* an
17 *s.* is 32 *s.* which is 1 *l.* 12 *s.* make
prick againſt 17. and ſay 12 *s.* and 16 *s.*
28 *s.* make a prick againſt the 16. and (be
cauſe there is no more numbers to be added
ſet down the odd 8 *s.* under ſhillings, an
(being there is two pricks in the line of ſhi
lings) carry 2 to the place of pounds, ſayin
2 and 1 is 3, and 2 is 5, and 9 is 14, ſ
down 4, and carry 1 to the next line, an
ſay 1 and 8 is 9, and 3 is 12, and 2 is 1
which (becauſe it is the laſt) you muſt ſ
down, ſo is the total or groſs ſumm 144
8 *s.* 4 *d.*

Example 2. Let the numbers to be adde
together be 37 *l.* 16 *s.* 9 *d.* 3 *q.* 21 *l.* 9
8 *d.* 1 *q.* 13 *l.* 2 *s.* 9 *d.* 2 *q.*

Place the numbers as in the margine, draw a line under them, and begin with the leaſt denomination (which in this Example is farthings) firſt, ſaying, 2 *q.* and 1 *q.* is 3 *q.* and 3 *q.* is 6 *q.* which is one penn and 2 *q.* remaining, which 2 *q.* I pla under the line, and carry the one penny

l.	*s.*	*d.*
37	16	9.
21	09.	8.
13	12	9
72	19	3

he next row which is the place of pence, aying, 1 *d.* and 9 *d.* is 10 *d.* and 8 *d.* is 18 *d.* which is 1 *s.* and 6 *d.* [*Now againſt the* 8, *I make a prick with my Pen for my better remembrance, to ſignifie that there is one ſhilling to be carried to the place of ſhillings,*] then go on and ſay 6 *d.* and 9 *d.* is 15 *d.* which is 1 *s.* 3 *d.* therefore againſt 9. I make a prick with my pen, and (becauſe that is the laſt number) I ſet down the odd 3 *d.* under the place of pence, and (becauſe I find two pricks in the line of pence, therefore) I carry 2 *s.* to the place of ſhillings, ſaying, 2 *s.* which I carried, and 12 *s.* is 14 *s.* and 9 *s.* is 23 *s.* which is one pound and 3 *s.* remaining, I make a prick againſt 9. and going on, ſay 3 *s.* and 16 *s.* is 19 *s.* which (being there is no more numbers to be added, and being alſo leſs than 20 *s.*) I ſet under the line, and finding one prick in the line of ſhillings, I therefore carry one to the place of pounds, ſaying, one which I carried and 3 is 4, and 1 is 5, and 7 is 12, ſet down the 2 under the line (as in addition of numbers of one denomination) and carry 1 to the next row, ſaying, one that I carried and 1 is 2, and 2 is 4, and 3 is 7, which being the laſt I ſet down, and ſo the total or groſs ſumm is 72 *l.* 19 *s.* 3 *d.* 2 *q.*

Some other Examples ready wrought, for Learners to practice by.

l.	s.	d.
365	13	9
721	6.	3
200	00	0
69	13	4
1356	13	4

l.	s.	d.	q.
63	13.	4.	1
52	13.	9	3
61	5	2.	2
9	11	9	3
187	4	2	1

Thus much for *Addition of Engliſh Mo* which order is alſo to be obſerved in the a dition of the Moneys of other Countreys, that there is no difference, if you do know how many of the ſmaller denomina ons make one of the next greater. A what hath been here ſaid of *Money*, is lik wiſe to be underſtood of *Weights*, *Meaſu Time*, &c. Examples of all which here f low. And firſt of

Addition of Troy Weight.

The moſt uſual Commodities weighed this kind of weight, are *Gold*, *Silver*, *Pe and Bread:* and the ſeveral denominatio of this weight are *Pounds*, *Ounces*, *Pen weights* and *Grains*, whereof a *Grain* is t leaſt; of which,

24 Gra

24 Grains make one Penny weight.
20 Penny-weights make one Ounce,
and
12 Ounces make one Pound.

Now in the addition of this kind of weight, you muſt at every 24 Grains make a prick, and for every prick carry ſo many penny-weights to the place of penny-weights, [becauſe 24 grains make one penny-weight.] Again, at every 20 penny-weight make a prick, and for every prick carry ſo many ounces to the place of ounces, [becauſe 20 penny-weights make one ounce.] Laſtly, at every 12 ounces make a prick, and for every prick carry ſo many pounds to the place of pounds, [becauſe 12 ounces make 1 pound] as by Examples following will appear.

Example. Let the Numbers to be added together be 7 *l.* 11 *ou.* 13 *pw.* 19 *gr.* 6 *l.* 7 *ou.* 16 *pw.* 19 *gr.* 3 *l.* 7 *ou.* 9 *pw.* 6 *gr.* Place your numbers as in addition of money, each under other according to their reſpective denominations as in the margine, then draw a line under them, and begin your addition with the leaſt denomination

l.	*ou.*	*pw.*	*gr.*
7	11.	13	19
6	7.	16.	19.
3	7	9	6
18	2	19	20

nation firſt, *viz.* Grains; Saying, 6 *gr.* and 19 *gr.* is 25 *gr.* which is one penny-weight and one grain, make a prick againſt 19. and carry the odd grain to the number above, ſaying, 1 *gr.* and 19 *gr.* is 20 *gr.* which (becauſe it is leſs than one penny-weight) I ſet under the line, then finding one prick in the line of grains, 1 (therefore) carry one to the place of penny-weights, ſaying, 1 and 9 is 10 and 16 is 26, which is one ounce, and 6 penny-weight, make a prick againſt 16. and ſay 6 and 13 is 19, which (being leſs than an ounce) ſet under the line; then for the one prick, carry 1 to the place of ounces, ſaying, 1 and 7 is 8, and 7 is 15, which is one pound and 3 ounces, make a prick at 7 and ſay, 3 and 11 is 14, which is one pound and 2 ounces, ſet down the 2 ounces, and for the two pricks carry 2 pounds to the place of pounds, ſaying, 2 and 3 is 5, and 6 is 11, and 7 is 18, which ſet under the place of pounds, ſo is your addition ended and the ſumm is 18 *l.* 2. *oun.* 19 *pw.* 20 *gr.*

Other

Other Examples for Practice.

l.	*ou.*	*pw.*	*gr.*	*l.*	*ou.*	*pw.*	*gr.*
32	9.	12	16	0	10	17.	11
17	11.	6	9.	0	6.	0	5
34	8.	15.	10	0	0	16	8.
8	10	4	7	0	5	2	19
94	3	18	18	1	10	16	19

Addition of Avoirdupois little weight.

The Commodities weighed by this kind of weight are such as are garbleable, as *Ginger*, *Cloves*, *Mace*, *Pepper*, *Cinnamon*, &c. and the several denominations of this weight are *Pounds*, *Ounces*, and *Drachms*, of which

16 Drachms make one Ounce, and
16 Ounces make one Pound,

therefore prick at every 16 drachms, and for every prick carry so many ounces to the place of ounces. Again, prick at every 16 ounces, and for every prick carry so many pounds to the place of pounds, as by the Examples following appeareth.

Examples of Addition of Averdupois little weight.

li.	*ou.*	*dr.*	*li.*	*ou.*	*dr.*
12	11.	9	6	3.	7
76	5	12.	5	9.	12
32	10.	00	6	3	9.
91	7.	13.	10	00	00
32	13	7	5	7	9
246	00	9	34	2	5

Addition of Avoirdupois great weight.

By this weight are weighed all commodities that are sold by the Hundred (the Hundred weight containing 112 pound) as *Butter, Cheese, Wool, Flax, Corans*, &c. and the several denominations of this weight are Hundreds, Quarters, Pounds and Ounces, of which

16 ounces make one pound.
28 pound makes a quarter of an hundred.
4 quarters makes an hundred weight, *viz.* 112 pound.

wherefore, for every 16 ounces carry one pound, for every 28 pounds carry one quarter, and for every 4 quarters carry an hundred weight, as in the Examples following.

C.	q.	l.	ou.	C.	q.	l.	ou.
632	3.	16.	12.	35	1	9	11.
761	2	7	3	21	3.	2.	00
499	3.	12	9	16	2	14	12
1894	1	8	8	73	3	10	7

Addition of Cloth measure.

By this measure is commonly measured *Linnen* and *Wollen Cloth*, and all kind of *Stuffs*, *Silks*, *Sattins*, *Velvets*, &c. and the several denominations of this measure are *Ells*, *Yards*, *Quarters*, and *Nails*, of which

4 Nails make one quarter of a yard.
4 Quarters make one yard, and
5 Quarters of a yard make an ell.

Therefore, for every 4 nails carry one quarter, and for every 4 quarters carry one yard.

But for Ells, for every 5 nails carry one quarter, and for every 4 quarters carry one Ell, as in these Examples.

Yards	*qu.*	*nails*	*Ells*	*qu.*	*nails*
325	2	3.	631	3	3.
65	1	2.	25	1.	2
31	3.	1	16	3	4.
65	3.	2	31	2.	3
488	3	0	705	3	2

Addition of Dry measure.

By this measure is measured *Salt*, *Coal* and *Corn*, and the common denominations are *Bushels*, *Pecks*, and *Pints*, of which

16 Pints make one Peck, and
4 Pecks one Bushel.

Wherefore, for every 16 pints carry one peck, and for every 4 pecks carry one bushel as in the Examples following.

Bush.	*Peck*	*Pint*	*Bush.*	*Peck*	*Pint*
276	3	9.	161	3	13
162	0	4	91	2	12
630	3	12	64	3.	11
1069	3	9	318	2	4

Additi

Addition of Wine measure.

The denominations of Wine measure are *Tuns*, *Hogsheads*, *Gallons*, *Pottles*, *Quarts*, *Pints*, of which

2 Pints make one quart.
2 Quarts one pottle.
2 Pottles one gallon.
63 Gallons one hogshead.
4 Hogsheads one Tun.

Therefore for every 2 pints carry one quart.
For every 2 quarts one pottle.
For every 2 pottles one gallon.
For every 63 gallons, one Hogshead.
and
For every 4 Hogsheads, one Tun.
as in the Example.

Tun	*hogsh.*	*gal.*	*pottle*	*quart*	*pint.*
632	3	60.	1	0	1.
269	2.	40	0	1.	0
672	1	16	1.	0	1
1574	3	54	1	0	0

Addition of Long measure.

By which is measured any *Distance*, as from one place to another, or the *height* of any Building, or the *length* of any Gallery, or of any piece of *Timber*, or Masts of Ships, &c. The usual denominations whereof are *Yards*, *Feet* and *Inches*, of which

12 Inches make one Foot, and
3 Foot one yard.

Therefore, for every 12 Inches carry one foot; and for every 3 foot carry one yard, as in these Examples:

Yards	*feet*	*inches.*	*Yards*	*feet*	*inches.*
3261	2.	9.	325	1	11.
376	1	0	96	2.	3.
127	2.	10	64	0	10
3766	0	7	486	2	00

Addition of Time.

Time is measured by *Years*, *Dayes*, *Hours* and *Minutes*, of which

60 Minutes make one hour.
24 Hours one day natural, omitting the odd hours, which in 4 years makes one day, and is added in *February* every Leap-

Leap-Year; And
365 dayes one year.

Wherefore, for every 60 minutes carry one hour, for every 24 hours carry one day, and for every 365 dayes carry one year, as in the Examples following.

Years	*days*	*hours*	*minutes.*
5670	208	16.	30
654	345.	20.	45.
276	16	11.	24
69	54	23.	52
6670	258	00	31

Let this suffice for the practice of Addition; next for the proof thereof.

The Proof of Addition.

Having placed your numbers in order, and added them together, and set the Total under the line, *Cut off the upper number by drawing a line with your Pen betwixt that and the others, then add all the numbers together except the uppermost, and set the Total of them under the Total before found, then add this last Total, and the first number which you cut off with your Pen together, and if the sum of those two numbers be equal with your total sum first found, then is your work right; otherwise not.*

Example. In the first example of whole numbers, the sums to be added were 937, 772, and 53, these numbers placed in due order and added together, the total or gross sum of them was 1762; now to prove whether this Total be true or not, I cut off the uppermost number (to wit 937) with a dash of the Pen, and I add the other two numbers together, namely, 772, and 53, and the total of them is 825, which number being added to 937, (the number cut off) the sum of them is 1762, exactly agreeing with the Total first found, and proves the addition was truly performed; But if they had disagreed, then the work had been erroneous. The like course must be taken for the proof of those sums which have different denominations; as in Money and Weight, as by the Examples following will appear.

Another Example.

	7822
	5609
	376
	8547
first total	22354
last total	14532
Proof	22354

Other

Other Examples proved.

1 *Exam. of Money.*

	li.	*s.*	*d.*	*q.*
	37	16	9	3
	21	9	8.	1
	13	12	9	2
1 Total	72	19	3	2
2 Total	35	2	5	3
Proof	72	19	3	2

2 *Exa. of Troy weight.*

li.	*oun.*	*pwt.*	*gr.*
32	9	12	16
17	11	6	9
34	8	15	10
8	10	4	7
94	3	18	18
61	6	6	2
94	3	18	18

CHAP. III.

Of SUBSTRACTION.

AS by Addition was taught, that by the adding of two or more numbers together, there was produced another number which was equal to all the other numbers, and was called the Sum or Total of them. So Substraction teacheth the contrary, namely, by having one or more small sums to be taken out of one greater sum, it sheweth what part of the greater sum is left behind when such substraction is made, which part so left behind is called the *Remainder*, or *Residue*.

And as in *Addition* the sums to be added may be either of the same denomination, or of different, so also may they be in *Substraction*, and the manner of placing them is the same, that is, *Unites* under *Unites*; *Tens* under *Tens*, &c. placing always the greater number uppermost, as by Examples following will appear.

1. Sub-

1. Subſtraction *of numbers of one denomination.*

Example 1. Let it be required to ſubſtract 2976 out of 96527.

The RULE.

Place the numbers one under another as in Addition, and draw a line under them, and beginning with the firſt figure towards your left hand, ſay 6 *out of* 7, and there remains 1, place 1 under the line, and proceed to the next figure, ſaying 7 out of 2 I cannot (*wherefore you muſt always add* 10 *to the number above, which in this Example is* 2, *and it makes* 12,) therefore take 7 out of 12, and there remains 5, place 5 under the line, and (*becauſe you added* 10 *to the* 2 *to make it* 12, *you muſt*) carry a unite to the next figure, ſaying, one which I carried and 9 is 10, take 10 out of 5, which I cannot, therefore I muſt add 10 to 5, and it makes 15, and ſay 10 out of 15, and there remains 5, place 5 under the line, and (*becauſe you added* 10 *to* 5 *to make it* 15, *you muſt therefore*) carry a unite to the next figure, ſaying, one which I carried and 2 is 3, take 3 out of 6 and there remains 3, place 3 under

	96527
	2976
	93551

der the line, and becauſe there is no more figures to be ſubſtracted from the number above, you muſt ſay, nothing from 9 and there remains 9, ſet the 9 under the line, and your ſubſtraction is ended.

Other Example.

Out of	9635	quarters of Wheat
Take	964	quarters
Remains	8671	quarters.

Bought	2106	hogſheads of Wine
Sold at ſeveral times	120 235 94	hogſheads
Sold in all	449	hogſheads
Remains	1657	hogſheads unſold.

Subſtraction *of Numbers of divers denominations.*

The RULE.

In ſubſtraction of Numbers of divers denominations, you muſt obſerve the ſame order as in Addition, namely, to place every number in due order, with reſpect to its denomination, as pounds under pounds, ſhillings under ſhillings, &c. the greater number always uppermoſt, and drawing a

line under them, begin with the leaſt denomination firſt, ſubſtracting it from the line above, and ſetting the remainder under the line as in whole numbers; but if the pence or ſhillings in the upper row be ſmaller than thoſe in the neather row, you muſt add 12 d. or 20 s. to the ſmaller number, that ſo ſubſtraction may be made, as by examples following will appear.

Example. Let it be required to ſubſtract 2628 *l.* 16 *s.* 10 *d.* out of 9320 *l.* 10 *s.* 7 *d.* place the numbers in order, and beginning with the pence, ſay 10 out of 7 I cannot, therefore I muſt add 12 *d.* (which is one ſhilling) to 7 *d.* and it makes 19 *d.* but 10 *d.* out of 19 *d.* and there remains 9 *d.* ſet the 9 *d.* under the line, and (becauſe I added 12 *d.* to 7 *d.*) I muſt therefore carry one to the place of ſhillings, ſaying, 1 *s.* which I carried, and 16 *s.* is 17 *s.* then 17 *s.* from 10 *s.* I cannot take, wherefore I muſt add 20 *s.* (which is one pound) to 10 *s.* it makes 30 *s.* and 17 *s.* out of 30 *s.* and there remains 13. ſet 13 under the line, and carry one to the place of pounds, ſaying, one which I carried and 8 is 9, take 9 out of 0 I cannot, but 9 out of 10 and there

	l.	*s.*	*d.*
Lent	9320	10.	7
Paid	2628	16	10
Reſts	6691	13	9

there remains one, set 1 under the line, and carry a unite to the next place, saying, or which I carried and 2 is 3, take 3 out of 2 cannot, but 3 out of 12, and there remain 9, place 9 under the line, and carry one to the next place, saying 1 which I carried and 6 is 7, take 7 out of 3 I cannot, but 7 out of 13, and there remains 6, place 6 under the line, and carry one to the next row saying 1 and 2 is 3, take 3 from 9 and there remains 6, place 6 under the line, so is your Substraction ended, and the remainder is 6691 *l.* 13 *s.* 9 *d.*

Example. 3. Suppose a man had lent to another man 1000 pound, and that the borrower had paid thereof at one time 127 *l.* at another time 430 *l.* 10 *s.* and at a third payment 50 *l.* and the Creditor would know how much he hath received, and how much is owing of his Debtor.

	l.	*s.*	*d.*
Money lent	1000	00	00
	127	00	00
Paid at several times	430	10	00
	50	00	00
Paid in all	607	10	00
Rests to pay	392	10	00

Place the numbers as here you see, first the sum of money lent, and draw a line under it,

it, then set the sums paid at several times one under another, and draw a line under them: Then add all the sums which have been paid at several times together, which make 607 *l.* 10 *s.* which is the sum which the Debtor hath paid in all, then substract this 607 *l.* 10 *s.* from 1000 *l.* and there will remain 392 *l.* 10 *s.* and so much is still owing to the Creditor.

Another Example.

	l.	*s.*	*d.*	*q.*
Money in Cash	3962	9	3	2
Goods bought at Money	1276	8	9	1
Paid for Custom	176	11	2	0
Disburst	1452	19	11	1
Rests in Cash	2509	9	4	1

Example in Troy-weight.

	Oun.	*pw.*	*gr.*	
Received	635	16	12	of Plate.
Returned	467	13	7	of Plate.
Remains	178	3	5	

Example

Example in Avoirdupois great weight.

	C.	qr.	l.	ou.	
Bought	621	3	20	10	of Cheeſe.
	12	0	6	4	
Sold at ſe-	9	3	12	1	
ral times	16	2	9	7	
	32	3	11	12	
Sold in all	71	1	11	8	
Unſold	590	2	9	2	

The Proof of Subſtraction.

The Proof of Subſtraction is performed by Addition, for adding the number to be ſubſtracted, to the remainder, the ſum of them muſt be equal to the number given, if you have truly wrought. As in the Example of numbers of one denomination,

the number given is	96527
the number to be ſubſtracted is	2976
the remainder is	93551
Proof	96527

CHAP

CHAP. IV.

Of MULTIPLICATION.

MULTIPLICATION is no other than a Compendium of Addition, neither doth it perform any thing that may not be done thereby, only Multiplication performeth that at one working, which to perform by Addition would require many, as if you would know how much 26 times 8 is, it would be tedious to set down 26 eight times, and then to add them together, which when you had done, you should find the sum to be 208, this I say to perform by Addition would be tedious, but by Multiplication very expeditious and easie, as will appear.

Before you enter upon the practice of *Multiplication*, it it is necessary to have in remembrance perfectly the product produced by the Multiplication of any one of the nine Digits, by any other of the same, as readily to know, that 4 times 5 is 20, 6 times 7 is 42, 2 times 9 is 18, 7 times 9 is 63, 8 times 9 is 72, *&c.* Which this Table following will plainly declare, and must be perfectly learned by heart before you attempt to multiply great numbers.

The

The Table of Multiplication.

1	2	3	4	5	6	7	8	
2	4	6	8	10	12	14	16	1
3	6	9	12	15	18	21	24	2
4	8	12	16	20	24	28	32	3
5	10	15	20	25	30	35	40	4
6	12	18	24	30	36	42	48	5
7	14	21	28	35	42	49	56	6
8	16	24	32	40	48	56	64	7
9	18	27	36	45	54	63	72	8

The use of the Table of Multiplication, and manner how to read it.

The use of this Table is to find the ſ or product of any digit multiplied by it or of any two digits multiplied one by th ther, as if you would multiply 8 by 8, l in the ſquare of the Table, where the lines from 8 in the ſide of the Table, a in the top of the Table do meet, and in ſquare you ſhall find 64, and ſo much i ſum or product of 8 multiplied by 8.

Again, if you would multiply 6 by 8, in the ſide of the Table for 6, and in th

of the Table for 8, and in that ſquare where 6 in the ſide and 8 in the top do meet, you ſhall find 48, and ſo much is the ſum or product of 6 multiplied by 8, or of 8 multiplied by 6, which is all one, for 6 times 8, and 8 times 6 is one and the ſame.

So in the Table, if you find 8 in the ſide of the Table and 6 in the top, in that ſquare where thoſe two lines meet, you ſhall alſo find 48, as before.

And ſo for any other two digits, as 7 times 8 is 56, 4 times 9 is 36, 8 times 5 is 40, and ſo of any other two digits.

A second Table of Multiplication.

2	2	4
	3	6
	4	8
	5	10
	6	12
	7	14
	8	16
	9	18
3	3	9
	4	12
	5	15
	6	18
	7	21
	8	24
	9	27
4	4	16
	5	20
	6	24
	7	28
	8	32
	9	36
5	5	25
	6	30
	7	35
	8	40
	9	45
6	6	36
	7	42
	8	48
	9	54
7	7	49
	8	56
	9	63
8	8	64
	9	72
9	9	81

This Table is so plain and obvious, it needs no other Direction but a bare inspection thereof.

So 2 times, or twice 2 is 4,
2 times 3, or twice 3 is 6, *&c.*

In *Multiplication* three things or terms are to be considered, namely;

The *Multiplicand.*
The *Multiplier*, and
The *Product.*

The *Multiplicand* is the number to be multiplied.

The *Multiplier* is the number by which the *Multiplicand* is multiplied, and

The *Product* is the number which is produced by the multiplication of the *Multiplicand* and the *Multiplier* together.

Thus, if it were required to multiply 8 by 7, here 8 is the *Multiplicand*, 7 the *Multiplier*, and 56 is the *Product*, for 8 times 7, or 7 times 8, is 56.

In *Multiplication* it mattereth not which of the two numbers given is made the *Multiplicand*, or which the *Multiplier*, for the *Product* produced by either will be the same, but the usual and best way is to make the greater number the *Multiplicand*, and the lesser number the *Multiplier*, except one of the numbers have one or many Cyphers on the right hand thereof, as these and such like numbers, 100, 230, 9000, in such like numbers it will be best to make the greater number the *Multiplier*, and the lesser number the *Multiplicand.*

To perform the work of *Multiplicati* this is

The RULE.

The Numbers to be multiplied must be set under another, viz. *the* Multiplicand *(or gre number) above*, *and the* Multiplier *(or le number) below*, *the last figure of the Mul plier under the last figure of the Multip cand*; *Then draw a line under them*, *a (having learned the foregoing Table perfe by heart) multiply every digit of the Mul plier*, *into every digit of the* Multiplican *setting the several Products under the l then having finished your Multiplication*, *dr a line*, *and add all the Products toget and the summe of those Products is the g neral Product of the whole Multiplica on*, *as by the following Examples will pear.*

Example 1, Let it be required to mu ply 736 by 7, that is, let it be required know how many dayes there are in 7 Weeks; First, I write down 736 the M tiplicand, and under it 7, the Multiplier, under them I draw a line, then I multiply into every digit of the Multiplicand, sayi

7 ti

times 6 is 42, place 2 under the line under 7, and for the four tens keep 4 in mind, then say again, 7 times 1 is 21, and 4 which I kept in mind is 25, place 5 under the line, and keep the two tens in mind, then say again, 7 times 7 is 49, and two which I kept in mind is 51, place 1 under the line, the 5 tens (because there is no more figures to be multiplied) I set down under the line also, so is the work ended, and the product of this Multiplication is 5152, and so many dayes there are in 736 Weeks.

Weeks	736	Multiplicand
	7	Multiplier
dayes	5152	Product

Example 2. Let it be required to multiply 3417 by 5, as if it were demanded, How many shillings are there in 3417 Crowns? Place the numbers under one another, and draw a line under them as in the Example, then begin your Multiplication, saying, 5 times 7 is 35, place 5 under the line, and keep the three tens in mind, then say again, 5 times 1 is 5 and 3 which I kept in mind is 8, place it under the line, and

Crowns	3417	Multiplicand
	5	Multiplier
Shillings	17085	Product

(because

(becauſe it is leſs than 10, I keep nothing mind) then ſay again, 5 times 4 is 20, pl the cypher 0 under the line, and keep two tens in mind; laſtly, ſay 5 times 3 15, and 2 which I kept in mind is 17, wh 17 being the laſt number I place under line, and ſo my Multiplication is ended, a the Product is 17085, and ſo many ſhilli are there in 3417 Crowns.

Example. 3. In the two foregoing Exa ples, the Multiplier conſiſted but of one git, we will now ſhew how Multiplication performed when the Multiplier conſiſts more than one Figure, therefore in this Example, let it be required to multiply 5704 by 37, as if 5704 poor men were to have 37 ſhillings a man, how many ſhillings muſt there be pay them? Place your numbers, and dr a line under them, as you ſee in the Exa ple, then begin your Multiplication in manner, ſaying, 7 times 4 is 28, ſet 8 der the line, and keep the two tens in m then ſay 7 times nothing is nothing, but two tens in mind is 2, ſet 2 under the l then ſay 7 times 7 is 49, ſet 9 under

5704	Multiplica
37	Multiplier
39928	
17112	
211048	Product

ine, and keep 4 in mind; then laſtly, ſay times 5 is 35, and 4 in mind is 39, which eing the laſt number to be multiplied I ſet own under the line, ſo is the multiplica- ion of one of the digits (namely 7) fi- iſhed.

Then begin to multiply the ſecond digit, aying 3 times 4 is 12, place 2 in the ſecond ine, one place forwarder towards the left and, and keep 1 in mind, then ſay three imes nothing is nothing, but 1 in mind is , ſet down 1 by the 2 in the ſecond line; hirdly, ſay 3 times 7 is 21, place 1 in the econd line, and keep the two tens in mind; aſtly, ſay 3 times 5 is 15, and 2 in mind s 17, which 17 (becauſe there is no more igures to be multiplied) I place in the ſe- ond line alſo.

Having thus done, I draw a line under hem, and add theſe two lines together, as common Addition or numbers of one de- omination, ſaying 8 is 8, place 8 under the ne, then ſay 2 and 2 is 4, place 4 under he line, then ſay 1 and 9 is 10, place a cy- her under the line, and carry 1 to the ext place, ſaying 1 and 1 is 2, and 9 is 11, lace 1 under the line, and carry 1 to the ext row, ſaying 1 and 7 is 8, and 3 is 11, lace 1 under the line, and carry 1 to the ext place, ſaying, 1 which I carry and 1 is

2, place 2 under the line, and so is your multiplication ended, and the Product is 2110... And so many shillings must be provided to pay 5704 poor men 37 shillings piece.

Example. 4. Let it be required to multiply 57325 by 4032, place the multiplicand and multiplier one under another, and draw a line as before, then proceed to the multiplication as formerly; saying, first, 2 times 5 is 10, set down a cypher and keep 1 in mind, then 2 times 2 is 4, and 1 in mind is 5, place 5 under the line, then 2 times 3 is 6, set 6 under the line; then 2 times 7 is 14, down 4, and keep 1 in mind, then 2 times 5 is 10, and 1 in mind is 11, which (being the last) I set down. The multiplication of one of the digits being finished, proceed to the multiplication of the next, saying 3 times 5 is 15, set down 5 in the second line, one place more towards the left hand, and keep 1, then 3 times 2 is 6, and 1 is 7, set down 7, then 3 times 3 is 9, down 9, then 3 times 7 is 21, set down

57325 Multiplicand
4032 Multiplier
114650
171975
229300
221134400 Product

nd keep 2 in mind, then 3 times 5 is 15, nd 2 in mind is 17, which being the laſt ſet own alſo.

Two of the figures of the multiplier being iniſhed, proceed to the third, which (in this Example) being a cypher, you may wholly neglect, and proceed to the multiplication of he fourth figure, only remember to remove he product of the fourth figure one place more to the left hand, as in the Example you may ſee, for the cypher, which is in the Multiplier, I ſet a cypher under 7, for a cypher muſt keep his place, and the Figures following muſt be removed a place farther.

Then for the multiplication of the fourth nd laſt digit, ſay 4 times 5 is 20, ſet down cypher (under 9) and keep 2 in mind, then times 2 is 8, and 2 in mind is 10, ſet own a cypher and keep 1 in mind, then 4 imes 3 is 12, and 1 is 13, ſet down 3 and eep 1, then 4 times 7 is 28, and 1 kept is 9, ſet down 9 and keep 2, then 4 times 5 20, and 2 kept is 22, which 22 (becauſe he multiplication is ended) ſet down alſo.

Having thus multiplied all the digits ſeveally, draw a line under their products, and dd them all together as in the former Exmple, ſo ſhall you find their general product to be 231134430.

Other Examples for Practice.

40326	73580
5432	50032
80652	147160
120978	220740
161304	36790000
201630	3681354560
219050832	

Three brief Notes or Compendiums, *useful in Multiplication.*

1. If the Multiplier consist of cyphers in the last place or places, you may omit the multiplication of them, and place the former figures of the Multiplier under the Multiplicand, thus if it were required to multiply 3257 by 2600, place the numbers as you have in the margine, then multiplying 3257 by 26, the Product will be 84682, to which if you add two cyphers (becaufe there were two cyphers in the Multiplier) it will be 8468200, which is the true Product of the Multiplication.

3257	
26	
19542	
6514	
84682	

2. If it be required to multiply any number by 10, 100, 1000, 100

ve. You have no more to do but to add ſo many cyphers to the Multiplicand, as there are cyphers in the Multiplier, thus if you were to multiply 365 by 10, the Product will be 3650, or by 100, it would be 36500, or by 1000, it would be 365000, or by 10000, it would be 3650000, *&c.*

3. If any number given were to be multiplied by 5, you may abbreviate your work thus, add a cypher to the Multiplicand, take half that number, and it ſhall be the Product required, thus if it were required to multiply 1627 by 5, add a cypher to the Multiplicand, then it is 86270, the half whereof is 43135, which is the product required.

Rules in Verſe to multiply by a ſingle Figure.

IF you deſire to multiply by Two,
Your doubled *ſumm alone the ſame doth do,*
Triple your ſumm to multiply by Three;
By Four *your number muſt redoubled be.*
By Five *take half your ſingle ſumm and then,*
Put to a Cypher *as it us'd by* Ten,

But odd ſumms part not juſt in ſuch a caſe,
The Figure Five *muſt take the* Cyphers *place,*
Your ſingle ſumm unto Fives product add,
And ſo the product made by ſix *is had;*
Five's *Product and your doubled ſumm doth make*
The Product ſeven affords without miſtake;
Put to your ſingle ſumm a cypher *ſo,*
'Tis quickly multiplied by Ten *you know;*
From which ſubſtract your double ſumm again,
[ſtreight
You have the Product, which is made by eight.
Or take your ſingle ſumm thence if you pleaſe,
To have nines *Product, all is done with eaſe.*

The proof of Multiplication.

The moſt certain proof of Multiplication is by Diviſion, but becauſe diviſion is not yet taught, I will here ſhew a near way by which Multiplication may be proved. Which is thus,

The RULE.

Make a Croſs as in the Margine, then, the ſumms being multiplied, you may prove the truth of your work in this manner, (1) *Caſt away all the nines which you can find in the Multiplicand, what remaineth ſet on the right ſide of the*

X

2.) Cast away also the nines in the Multiplier, and what remains set on the left side of the Cross. (3.) Multiply the figure on the right side of the Cross by that on the left side of the Cross, and out of that product cast away the nines, setting the figure remaining over the Cross, Then (4) cast away all the nines in the product; and if the figure remaining be the same with that which standeth over the Cross, then is your Multiplication truly performed, otherwise not.

Example 1: Let it be required to prove the following Summ.

4324	
23	
12972	
8648	
99552	

1. Cast away all the nines in the Multiplicand, saying 4 and 3 is 7, and 2 is 9, which being rejected there remains 4, which I set on the right side of the Cross, then

2. Cast away all the nines in the Multiplier: saying 2 and 3 is 5, which being less than 9, I set on the left side of the Cross, then

3. Multiply 4 by 5, saying 4 times 5 is

20, from which caſt all the nines, and ther remains 2, place 2 over the Croſs, and

4. Caſt away all the nines in the Produc ſaying, 2 and 5 is 7, and 4 is 11, caſt awa 9, and there remains 2, which exactly agree with the figure over the Croſs, and demon ſtrates that the multiplication is truly per formed.

But the beſt proof of Multiplication is b Diviſion, for Diviſion and Multiplication d interchangeably prove one another; for i Diviſion if you multiply the Diviſor by th Quotient, the product will be equal to th Dividend; and in Multiplication, if the Pro duct be divided by the Multiplicator, th Quotient will give you the Multiplicand; o if the Product be divided by the Multiplican the Quotient will give you the Multiplicato But the proof of Multiplication by caſtin away the nines (though rightly uſed) ſome times a falſe Product will be affirm'd to b true; Example, if 3462 be multiplied b 786, the true Product is 2721132. But if ſay 4953132, or 3153132, is the Produc (or many other numbers which may be gi ven) the proof by nines will confirm them to be true Products, though they are falſe as will be evident to ſuch as know the Rul *Vide* Wingates Arithmetick, *Chap.* 6.

Many Queſtions that appertain to the Rul

of Three (commonly called the Golden Rule) may be performed by Multiplication only, of which I will give you some Examples.

If 1 day be 24 hours, how many hours are

	365	dayes.
	24	
	1460	
	730	
hours	8760	

If 1 *l.* be 20 *sh.* how many shillings is

	2764	*l.* ?
	20	
shillings	55280	

If 1 foot be 12 Inches, how many Inches in

	2760	Foot.
	12	
	5520	
	2760	
Inches	33120	

If 1 Acre be 160 square Poles or Perches, how many Pole is 3698 Acres ?

	160
	221880
	3698
Square Poles	591680

Infinite questions of this kind might be proposed, but let these suffice, and so I conclude Multiplication.

CHAP. V.

Of DIVISION.

WHat affinity *Multiplication* hath to *Addition*, the same hath *Division* to *Substraction*, for *Division* may be performed (but with much labour) by *Substraction*, as *Multiplication* might be by *Addition*. For *Multiplication* turns great denominations into smaller, and *Division* turns smaller denominations into greater, as by Examples following will be made appear.

In Division three things are chiefly to be minded, namely.

1. The Dividend, or number to be divided, which is always the greatest number of the Three.

2. The *Divisor*, which is that number by which the Dividend is to be divided.

3. The *Quotient*, which is the number produced by the dividing of the Dividend by

the Diviſor, and always conſiſts of ſo many Unites as the *Diviſor* may be taken out of the *Dividend.*

To perform Diviſion there are ſeveral wayes, but that which is moſt uſually practiſed in Schools is that which followeth; for the performance whereof, this is

The RULE.

Place the Diviſor *under the* Dividend, *ſo that the figures next to the left hand ſtand directly one under the other: having ſo placed them, try how many times the lower figures are contained in the upper figures, and write that figure which anſwereth the queſtion within a crooked line in the margine of the work, which is called the* Quotient, *and by that figure multiply the firſt figure of the* Diviſor, *and take the Product out of the figure directly over it, beginning the Subſtraction toward the left hand; then cancel that figure of the Diviſor, and alſo, that of the Dividend which hath been already made uſe of, by giving it a light daſh with a Pen, and write the remain juſt over the figure cancelled: then proceed to do the like with the ſecond, third, and fourth figure of the Diviſor (if there be ſo many) till you have cancelled it all, and then have you finiſhed one work.*

Now

Now if the Dividend have ſtill ſome figur untouched towards the right hand, then remo the Diviſor ſtill toward the right hand, b one place at a time, and then again ask (a try) how many times the lower may be had the upper, and write the anſwer in the Quo ent, whether it be 1 or more, (only it cannot above 9) and if it can be had never a tim then put 0 in the Quotient, then multiply t Diviſor by this new figure, and ſubſtract t Product, ſetting the remainder orderly abo as before; this work muſt be repeated by r moving the Diviſor ſtill one place towar the right hand, until you come to the laſt gure of the Diviſor, and then the work is niſhed.

Example 1. Let it be required to divi 4096 by 3. As if 4096 ſhillings were giv to be diſtributed to ſeveral poor people, ea perſon to have 3 ſhillings, how many perſons muſt there be? Place the number as here you ſee.

4096 (
3

Then ask how many times 3 in 4, t anſwer is Once, which put within a crook line by it ſelf, as here you ſee done.

Then, in your mind multiply the Divi 3 by the quotient 1. And having ſaid the

wor

words, once 3 is 3, preſently cancel the 3. And having added theſe words, out of 4, cancel the 4. And after theſe words, and there remains 1, write one juſt over the 4, as you ſee here done.

1
4096 (1
3

Then remove the Diviſor one place towards the right hand, ſaying, how many times 3 in 10, the anſwer is, 3, write 3 in the quotient; and in your mind multiply the Diviſor 3 by the quotient 3, the product is 9, wherefore ſay three times three is nine, out of ten over head, and there remains one, then (having cancelled the 3 and the 10) write over them 1.

11
4096 (13
33

Again, remove the Diviſor 3, one place more, asking how many times 3 in 19? the anſwer being 6, write 6 in the quotient, and ſay 6 times 3 is 18 out of 19, and there remains 1, wherefore having cancelled the 3, and the 19, write 1 over 9, and remove the Deviſor once more, and ask *how many times* 3 *in* 16?

111
4096 (136
333

16? anſwer is 5, which write in the quotient, then in mind ſay 5 times 3 is 15 out of 16, and there remains 1, and cancelling the 16 and the 3, write 1 over 6. Now becauſe the Diviſor 3 is advanced ſo far till it is come to ſtand under 6 in the Dividend, which 6 is the laſt Figure there, the Diviſor cannot be removed any more, and therefore the Diviſion is ended, and the quotient being 1365, ſhews that the Diviſor 3 is contained in the Dividend 4096, 1365 times; and 1 remaining, which 1 being leſs than the Diviſor 3. doth not contain it once, but one third part of once, which ſheweth there muſt be 1365 perſons, and then there will be one ſhilling over. The proof of Diviſion is by multiplying the quotient into the Diviſor, and to the product add the remain; then if the work be well done, the ſumm ſhall be equal to the Dividend.

XXXI	
4096	(1365
3333	

So 1365 the quotient, multiplied by 3 produceth 4095, to which adding the remain 1, the ſumm 4096 is equal to the Dividend, which proveth the work to be true.

Here we divided onely by one figure, whereof we will take another Example, to make the work eaſie and clear, and to be a fair introduction

introduction to the multiplying by more figures than one.

Example 2. Suppose the same 4096 were to have been divided by 8, that is, every poor person were to have 8 shillings, how many persons must there then be?

The work must have stood thus, namely; the 8 must not have stood under the 4, as the 3 did in the former Example but under the 0, because 8 is greater than 4, and cannot therefore be taken out of it, therefore you must see how many times 8 you can have in 40, which you may have 5 times, set 5 in the quotient, then how many times 8 in 9, once and 1 remain, set 1 in the quotient, and 1 over 9, then how many times 8 in 16 twice, set 2 in the quotient and there remains nothing, so the quotient is 512 (which is one place less) and so many poor persons must there be, and no shillings remaining.

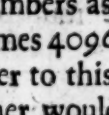
```
  1
4096 (512
 888
```

Example 3. Let it be required to divide 1310720 by 4096, as if one Vessel of Wine should contain 4096 Pints, how many such Vessels would 1310720 Pints fill?

```
1310720 (
 4096
```

Place

Place your numbers as here you ſee, and ask how many times 4096 is there in 13107, to find an Anſwer to this Queſtion immediately, to a learner would be hard, let him therefore ask how many times 4 can he have in 13, which he can readily do, and ſay three times, then put 3 in the quotient, and ſay 3 times 4 is 12, which ſubſtract out of 13 over it, ſaying 2 out of 3, and there remains 1, and 1 out of 1 and there remains 0, cancelling the 4 and 1 and ſet the remain 1 over the 4, as you ſee



Then go on ſaying, 3 times 0 is 0, out of 11, and remains ſtill 11, again, 3 times 9 is 27, take 7 out of 10 there remains 3, to be ſet over the 0, which is over 9, and 1 with 1 borrowed (to make the 0, 10, from the which the 7 was taken) is 3, and 3 out of 11, remains 8, which write over the place of 0 in the Diviſor, cancelling the 9 in it and alſo thoſe figures of the Dividend 110 out of which you have taken any thing; laſtly, ſay 3 times 6 is 18, take 8 out of 7 I cannot, therefore (borrowing 10) ſay 8 out of 17 remains 9, which write over the 7, then in the next place, the 10 borrowed is 1, and the 10 in the 18 is 1 more; Say therefore 1 and 1 is 2, out of 3, and the remain

main is 1, which write over the 3, having still cancelled the figures which you have used orderly as you go.

Now the whole Divisor being cancelled, it must be removed on one place further, and placed as here. Then ask how many times 4096 in 8192? it will be found (because of the 0 after the 4) as often as 4 in 8, that is 2 times, put therefore in the quotient 2, and work as before, saying 2 times 4 is 8, out of 8 remains 0, then 2 times 0 is 0, out of 1 remains 1, then 2 times 9 is 18, take 8 out of 9 remains 1, (which put over the 9) and 1 out of 1 in the next place remains 0, then lastly, 2 times 6 is 12, that is 2 out of 2 there remains 0, and 1 out of 1, there also remains 0, cancel and put the remainder over as formerly.

```
   00
   ~~11~~
~~0~~~~1~~8~~3~~9~~0
~~1~~~~3~~~~1~~~~0~~~~7~~~~2~~0 (320
  ~~4~~~~0~~~~9~~~~6~~~~6~~~~6~~
   ~~4~~~~0~~~~9~~~~9~~
   40
```

Now again, the Divisor being all cancelled, should be removed, and ask how many times 4096 in 0000, the answer is 0, which being put in the quotient, the work is done.

And the quotient 320, shews that the Divisor 4096 is contained in the Dividend 1310720, three hundred and twenty times; and

and ſo many Veſſels, each of which contain 4096 Pints, will 1310720 Pints fill.

And whether the Diviſor have 2, 3, 5, or more places, the working is ſtill like this not differing from it at all.

Brief wayes or Compendiums in Diviſion.

As in Multiplication, ſo in Diviſion there are brief Rules, as if the Diviſor have one more cyphers towards the right hand, the cyphers may be placed orderly under the laſt figure or figures of the Dividend, and remain there till the work be done, which will much ſhorten it.

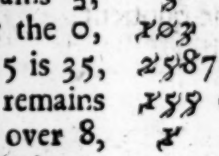
As if 2587645 were to be divided by 15000, place them thus, 2587645 (
15 000

And ſay how many times 15 in 25? anſwer is 1, which write in the quotient, and multiply in mind the diviſor by the quotient ſaying once one is one, out of 2 there remain 1, then cancel the 2, and the 1 under it and write the remaining 1 over it, as here done, then ſay once 5 is 5 out of 5, and there remains 0, therefore cancel the two fives, and over the uppermoſt write 0, then will the work ſtand thus:

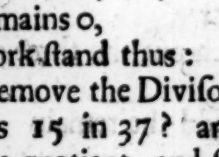
2587645 (
15 00

No

Now remove the Divisor one place, and ask how many times 15 in 108? answer is 7, which write in the quotient, and multiply, saying 7 times 1 is 7, out of 10 remains 3, which write over the 0, then say 7 times 5 is 35, take 5 out of 8 remains 3, which write over 8, and 3 out of 3 remains 0, then will the work stand thus:



Now again, remove the Divisor, and ask how many times 15 in 37? answer is 2, which write in the quotient, and say 2 times 15 is 30, out of 37 remains 7, and the Division is ended, the remaining being 7645, and the whole work finished will stand as followeth:



Proof

Proof of this.

Multiply the quotient 17
by the Divisor 15

86
17

The Product 258
Before which put the three cyphers, and the
it is 258000
To which add the remain 764
The total is 258764

Which is equal to the Dividend, and there
fore the work is right.

So if one would divide any summ by 10
100, 1000, 10000, *&c.* he need but cu
off the first, two first, three first, or fou
first figures towards the right hand, th
other figures shall be the quotient, and thos
cut off the remain.

As if 1587645 be divided by 1000, th
quotient is 1587, and the remain 645.

As many questions appertaining to th
Rule of Three, may be performed by *Multi*
plication only, so may divers be by *Divisi*
only, but all in general of that Rule by *Mul*
tiplication and *Division* jointly, as when w
com

come to that Rule will appear. In the mean time I would give you only four, which shall be just the converse of those I gave you in *Multiplication.*

If 365 dayes be 8760 hours, how many hours in one day?

```
 2
14
252
8760 (24 hours
3655
 36
```

If 55280 shillings be 2764 pounds, how many shillings is in one pound?

```
11
55280 (20 shillings
27644
276
```

If 2760 Foot be 33120 Inches, how many Inches is one Foot?

1
51
1650
33120 (12 Inches
27600
276

If 3698 Acres contain 591680 squ
Perches, how many Perches are in o
Acre?

45
214
2328
591680 (160 Perches.
369888
3699
36

Another way of Division, which is more e
than the former, and without cancelling
figure, and is proved by Addition.

THere is another kind of Division whi
is very much used, and is in most
quest with those who have most occasion
divide great numbers, the manner of wor
ing it is not difficult, for one or two exa
ples will make it plain.

Exa

Example 1. Let it be required to divide 162483 by 1321, ſet down your numbers as you ſee them placed in the margine, *viz.* Firſt, ſet down 162483 the Dividend, then on the left hand thereof ſet the Diviſor 1321 with a crooked line between them, then on the right hand thereof make another crooked line which muſt ſerve to ſet the figures of the quotient in, ſo are your numbers placed in due order, then draw a line under the Dividend, and make a prick under the figure 4, becauſe ſo far the figures of the Diviſor would extend if they had been placed underneath the Dividend, according as in the other Examples; this prick ſerves only to ſhew how far you have proceeded in your work, and muſt at every Diviſion be removed a place further, till at length you come to the laſt figure of the Dividend: your numbers being thus placed with a line under them, you are ready for the work, which muſt be performed according to the directions of the following Rule.

1321) 162483 (

The

The RULE.

Demand how often the Divisor may be h in the Dividend, and place that number in quotient, then multiply the Divisor by the q tient, and place the product under the li then substract this product from the Divid and set the remainder under the product, t make a prick under the next figure of the Di dend, and bring that figure down to the mainder, and then proceed as before.

Example, Your numbers being placed is before directed, you may begin your wo in this manner, first, say how many tim 1321 can I have in 1624, say once, place 1 in the quotient, by which 1 multiply the Divisor 1321, beginning at the left hand, saying, once one is 1, place 1 under the line, and under the first prick, then once 2 is 2, set 2 under the line, then once 3, place 3 under the line, lastly, once 1 1, place 1 under the line, then substract t 1321, from 1624 which is over it, a there will remain 303, to this 303 bri do

```
1321) 162483 (1
        ...
      ------
       132
        3038
      ------
       2642
        3963
      ------
       3963
       0000
```

down the next figure in the Dividend, namely 8, under which make a prick, ſo will that number be 3038, under which draw a line, and repeat the ſame work again, ſaying, how many times 1321 can I have in 3038, which may be had 2 times, place 2 in the quotient, by which 2 multiply the Diviſor 1321, ſaying 2 times 1 is 2, place 2 under the line, then 2 times 2 is 4, place 4 under the line, then 2 times 3 is 6, place 6 under the line; laſtly, 2 times 1 is 2, place 2 under the line, and ſubſtract this 2642 from 3038, and there will remain 396, to this 396 bring down the next figure of the Dividend, which is 3, ſo is this number made 3963, under which draw a line, and repeat the work once again, ſaying, how many times 1321 can I have in 3963, which may be had 3 times, by which 3 multiply the Diviſor 1321, ſaying 3 times 1 is 3, then 3 times 2 is 6, then 3 times 3 is 9, and laſtly, 3 times 1 is 3, which place under the line, and ſubſtract it from the line above, which in this Example is the ſame number, therefore there remains nothing, and the work is ended; but if any remainder had been, that ſhould have been ſet under the line, as by the Examples following will make appear.

Another Example for Practice.

5624) 793058 (141
...
5624
23065
22496
5698
5624
74 remains.

In this Example where 793058 is d
ded by 5624, you may perceive that
quotient is 141, and 74 remaining.

The Proof of this Division.

This kind of Division is proved by M
tion, for, *If you add the several Products*
ing from the Multiplication of the several q
ents into the Divisor, and also add thereun
remainder (if any be) the total of this Add
shall be equal to the Dividend, if there b
error in the work.

So in the Example following, where 76
is divided by 4325, if you add 4325 th
Product, and 30275.

```
        4325) 76321 (17
                ..
1 Product     4325
              33071
2 Product     30275
               2796 remain
              76321 Proof.
```

the second Product, and 2796 the remainder together, in the same order as they now stand in the Example, you shall find the total of this Addition to be 76321, equal to the Dividend, which demonstrates the work to be true. And thus much concerning Division.

Another Example of this kind of Division proved.

```
        2643) 7685904 (2908
                ....
1 Product     5286
              23999
2 Product     23787
               21204
3 Product      21144
Remainder         60
Proof        7685904
```

Another Example *at large for Practice of Multiplication and* Division, *by a Table of* Divisor *drawn into the* 9 Digits, *of great Use and ease in large Summs.*

```
  365768924  Multiplicand
      32147  Multiplicator
-----------
 2560382468
 1463075696
  365768924
  731537848
 1097306772
-----------
11758373599828  Product.
```

Divisor

321471) 117583735998 28 Dividend.

(3) = 96441 Subt.

211427 Rem.

(6) = 192882 Sub.

185453 Rem.

(5) = 160735 Sub.

247185 Rem.

(7) = 225029 Sub.

0221569 Rem.

(6) = 192882 Sub.

286879 Rem.

(8) = 257176 Sub.

297038 Rem.

(9) = 289323 Sub.

0077152 Rem.

(2) = 64294 Sub.

128588 Rem.

(4) = 128588 Sub.

000000 Rem.

Those Numbers on the left hand are the Quotient equal to the Multiplicand, and therefore proves the operation true.

The aforesaid Divisor drawn into the 9 Digi which is done easily by a continual Additi of the first number, by some called Tariffa.

	Divisor.
9	32147 — 1
	64294 — 2
	96441 — 3
	128588 — 4
	160735 — 5
	192882 — 6
	225029 — 7
	257176 — 8
	289323 — 9

96441
192882
160735
225029
192882
257176
289323
64294
128588

11758373599828

The proof of the *Division* by *Addition* the several summs substracted before in t *Division*, set in their natural Order.

CHA

CHAP. VI.

Of REDUCTION.

REDUCTION cannot properly be termed any real Rule of Arithmetick, but rather the Application, Uſe, or Proof of Multiplication and Diviſion, but thoſe that have written of it (as many do not mind it) do give it this definition.

To Reduce is to convert or change any number from one Denomination *to another, as ſometimes from leſſer to greater, and ſometimes from greater to leſſer.*

By which, Coins, Weights, and Meaſures may be reduced from one denomination to another, as from their *greater* terms to *leſſer*, and from their *leſſer* to their *greater.*

By this Rule you may reduce the Coins, Weights and Meaſures of one Country, into the Coins, Weights and Meaſures of another Country. For the working or performing whereof, this is,

A general Rule.

Any greater denomination is turned into a

leſſer by *Multiplication*, and any leſſer de nomination is turned into a greater by *Di viſion.*

1. To bring therefore a *greater* denomi nation into a *leſſer*, you muſt firſt conſide how many of the *leſſer* make one of th greater, and by that number you muſt alway *Multiply.*

2. To bring a *leſſer* denomination into greater, you muſt conſider how many of the *leſſer* make one of the *greater*, and by that number you muſt always *divide.*

The denominations of Engliſh money ar *Pounds*, *Shillings*, *Pence*, and *Farthings*, o which, four *Farthings* make one *Penny*, 12 *Pence* one *Shilling*, and 20 *Shillings* make one *Pound*; Therefore,

To bring { Pounds into Shillings / Shillings into Pence / Pence into Farthings } multiply by { 20 / 12 / 4

To bring { Shillings into Pounds / Pence into Shillings / Earthings into Pence } divide by { 20 / 12 / 4

Theſe

These two Questions are the converse of each other, and do prove each other, and so likewise do all those which follow.

In 567 *lib.* how many shillings? multiply 567 by 20.

567
20
11340

In 11340 *s.* how many pounds? divide 11340 by 20.

11340 (567 *li.*

In 532 *lib.* 6 *s.* 5 *d.* 3 *q.* how many farthings?

Multiply 532 by 20, it makes 10640, to which add the 6 shillings, it is 10646 shillings, that multiplied by 12 makes 127752, to which add the 5 pence, it is 127757 pence, that multiplied by 4, and the 3 farthings added makes 511031.

l.	s.	d.	q.
532	6	5	3
20			
10640			
6			
10646 shillings			
12			
21292			
10646			
127752			
5			
127757 pence			
4			
511028			
3			
511031 farthings.			

I needed not here have made a line, and set down the 6 odd shillings by it self, neither the 5 odd pence, nor the 3 odd farthings, but have added them in the work with the other figures. As in multiplying 432 by 20, I might have said 2 times 0 is 0, but 6 is 6. Likewise in multiplying 10646 by 12, I might have said 2 times 6 is 12, and 5 is 17, set down 7 and carry 1. Also in multiplying 127757 by 4, I might have said 4 times

4 times 7 is 28, and 3 is 31, ſet down 1 and carry 3; then would the work have ſtood as in this Example following.

l.	*ſ.*	*d.*	*q.*
532	6	5	3
20			
10646	ſhillings		
12			
21297			
10646			
127757	pence		
4			
511031	farthings.		

In 511031 farthings, how many pounds, ſhillings and pence?

Divide 511031 farthings by 4, and it makes 127757 pence and 3 farthings, that divided by 12, it gives 10646 ſhillings and 5 pence, that divided by 20 gives 532. So that in 511031 farthings, there are 532 *l.* 6 *ſ.* 5 *d.* 3 *d.* as by the work following you may perceive.

xx

xxxxx (39xx7 (5 d. (6 ſ.
xxxxxx (xx7757 (xx646 (532 l.
xxxxxx xxxxxx xxxx
xxxx

I have been the larger in this Example because I intend more brevity in those which follow.

In 16*l.* 12*s.* 0*d.* 1*q.* how many farthings?

l.	*s.*	*d.*	*q.*
16	12	0	1
20			
332	shillings		
12			
664			
332			
3984	pence		
4			
15937	farthings.		

In 15937 farthings, how many pounds, shillings, pence and farthings?

15937 (1*q.* 3984 (0*d.* 4 (1*s.* 332 (2 (16*l.*
4444 xxxx xxx
xx

But to reduce shillings into pounds, there is a nearer way, by cutting off the last figure towards your right hand, and taking half the other number which will be pounds, and

the figure cut off will be ſhillings. So 76534 ſhillings will be 3826 pounds 14 ſhillings, as by the work appeareth

1
7653|4
3826 *l.* 14 *ſ.*

In halving of any ſum, if 1 remains (as here) it ſignifieth 10 *ſ.* and is to be added to the laſt figure cut off.

Reduction of Troy-wright.

The denominations of Troy-weight are pounds, ounces, penny weights and grains, of which

24 Grains, 20 Penny-weight, 12 Ounces } make { 1 Penny-weight, One Ounce, One Pound.

Therefore,

To bring { Pounds into Ounces, Ounces into Penny-weight, Penny-weights into grains } multiply by { 12, 20, 24

To bring { Ounces into Pounds, Penny-weights into ounce, Grains into penny weights } Divide by { 12, 20, 24

In

In 26 pounds, 10 ounces, 12 penny-weight 6 grains, how many grains?

l.	*Oun.*	*p. w.*	*gr.*
26	10	12	6.
12			
52			
27			
322	Ounces		
20			
6452	Penny-weights		
24			
25814			
12904			
154854	Grains.		

In 154854 Grains, how many Pounds, Ounces, Penny-weights and Grains?

x		(1	
xx		*x*	
xxx(6	(1	*x*8	(0
*x*54854	(645	(2	(*xx*	(26 *l.*
*x*4444	*xxx*	0	*xxx*	
xxx			*x*	

	l.	*Oun.*	*p. w.*	*Gr.*
Anſ.	26	10	12	6

Reduction

Reduction of Avoirdupois Weight.

The denominations of this Weight are Hundreds, Quarters, Pounds and Ounces, of which

16 Ounces, 28 Pound, 4 Quarters } make { One Pound, One Quarter, One C. weight.

Therefore,

To bring { Hundreds into Quarters, Quarters into Pounds, Pounds into Ounces } multiply by { 4, 28, 16 }

To bring { Quarters into Hundreds, Pounds into Quarters, Ounces into Pounds } divide by { 4, 28, 16 }

In

In 5652 hundreds, 2 quarters, 19 pounds and 6 ounces Avoirdupois weight, how many Ounces?

C.	Q.	l.	Ou.
5652	2	19	6

```
      4
  22610 Quarters
     28
 180899
 45220
 633099 Pounds
     16
3798600
 633099
10129590 Ounces.
```

In 10129590 Ounces, how many hundred, quarters, pounds and ounces?

```
                 1
 21 12           35
454165(6        6776(1        221(2
10129590 (63309(9 (22610 (5652
  166666        288888        4444
   11111         2222
```

C.

	C.	Q.	L.	Ou.
Anſ.	5652	2	19	6

Reduction of Time.

Time is meaſured by Years, Days, Hours and Minutes, whereof

60 Minutes, 24 Hours, 365 Days } make { One Hour, One Day, One Year.

Therefore,

To bring { Years into Days, Days into Hours, Hours into Minutes } multiply by { 365, 24, 60 }

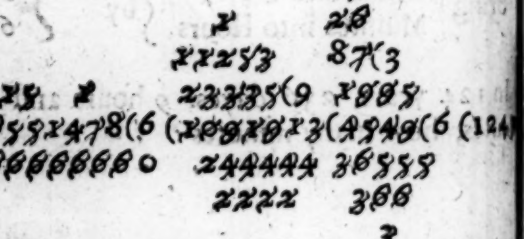
To bring { Days into Years, Hours into Dayes, Minutes into Hours } divide by { 365, 24, 60 }

In 124 years, 236 dayes, 9 hours and 6 minutes, how many minutes?

Years

Years	da.	ho.	m.
124	236	9	6
365			
626			
747			
374			
45496 dayes			
24			
181993			
90992			
1091913 hours			
60			
65514786 minutes.			

In 65514786 minutes, how many yea
days, hours and minutes?



Anſ. 124 *years* 236 *days* 9 *ho.* 6. *min.*

Reduc

Reduction of Wine-Measure.

The Denominations of Wine-Measure are Tuns, Hogsheads, Gallons, Pottles, Quarts and Pints: of which

2 Pints	make one	Quart
2 Quarts		Pottle
2 Pottles		Gallon
63 Gallons		Hogshead
4 Hogsheads		Tun.

Therefore,

To bring	Tuns into Hogsheads	multiply by	4
	Hogsheads into Gallons		63
	Gallons into Pottles		2
	Pottles into Quarts		2
	Quarts into Pints		2

To bring	Hogsheads into Tuns	divide by	4
	Gallons into Hogsheads		63
	Pottles into Gallons		2
	Quarts into Pottles		2
	Pints into Quarts.		2

In

In 26 Tun, 3 Hogsheads, 8 Gallons 1 Pottle, 1 Quart and 1 Pint, how many Pints?

Tun.	hogs.	gal.	pot.	qu.	pint.
26	3	8	1	1	1

4

107 Hogsheads

63

329

642

6749 Gallons

2

13499 Pottles

2

26999 Quarts

2

53999 Pints.

In 53999 Pints, how many Tuns, Hogsheads, Gallons, &c.

xxxxx(1 xx(1
xxxxx (xxxxx (13499
xxxxx xxxxx

x x(1 4x(8 x(3
xxxxx (x749 (xx7 (26
xxxx x3x3 44
66

	Tun	Hogs.	Gal.	Pot.	Qu.	Pint.
Anſ.	26	3	8	1	1	1

The Table of Equation for Engliſh Money.

	Marks	*Ang.*	*Nob.*	*Cr.*	*Sh.*	*Gr.*	*Pence*	*Farth.*
A Pound ſterling is	$1\frac{1}{3}$	=2	=3	=4	=20	=60	=240	=960
A Mark is	1	$=1\frac{1}{3}$	=2	$=2\frac{2}{3}$	=13 4^{d}	=40	=160	=640
An Angel is		1	$=1\frac{1}{3}$	=2	=10	=30	=120	=480
A Noble is			1	$=1\frac{1}{3}$	= 6 8^{d}	=20	= 80	=320
A Crown is				1	= 5	=15	= 60	=240
A Shilling is					1	= 3	= 12	= 48
A Groat is						1	= 4	= 16
A Penny is							1	= 4

The

The Table of Equation for Troy-weight.

	Lib.	*Oun.*	*Dpw.*	*Carots*	*Grains.*
One C. weight Troy is	100 =	1200 =	24000 =	28800 =	576000
½ C. weight is	50 =	600 =	12000 =	14400 =	288000
¼ One Troy is	25 =	300 =	6000 =	7200 =	144000
⅛ C. Troy is	12½ =	150 =	3000 =	3600 =	72000
One pound Troy is	1 =	12 =	240 =	288 =	5760
One ounce Troy is		1 =	20 =	24 =	480
One penny weight is			1 =	1⅕ =	24
One carat Troy is				1 =	20
One grain weight is					1

The Table of Equation for Avoirdupois weight.

Great Avoir. weight and small weight.

	Hhs.	C.	stones	lib.	ounces	dram.	scruples	grains.
One Tunne weight gral. is	4 =	20 =	280 =	2240 =	35840 =	286720 =	860160 =	17203200
One Hhs. is	1 =	5 =	70 =	560 =	8960 =	71680 =	215040 =	4300800
One C. is		1 =	14 =	112 =	1792 =	14336 =	43008 =	860160
One $\frac{1}{2}$ C. is			7 =	56 =	896 =	7168 =	21504 =	430080
$\frac{1}{4}$ of 1 C. is			$3\frac{1}{2}$ =	28 =	448 =	3584 =	10752 =	215040
$\frac{1}{8}$ of $\frac{1}{4}$ of 1 C. is			$1\frac{1}{2}$ =	14 =	224 =	1792 =	5376 =	107520
One Stone weight is			1 =	8 =	128 =	1024 =	3072 =	61440
One lib. is				1 =	16 =	128 =	384 =	7680
One ounce is					1 =	8 =	24 =	480
One dram is						1 =	3 =	9
One scruple is							1 =	3
One grain is								1

The

The Table of Equation for dry Measure.

		Lasts wei. cha. qu. bush. pecks pints.
Great and	One Last of dry Measure is	1=2=$2\frac{1}{2}$=10=80=320=5120
	One Weigh	1=$1\frac{1}{4}$= 5=40=160=2560
	One Chaldron of Coles is	1 = 4=36=144=2098
	One Quarter of Wheat is	1= 8= 32= 512
		Pecks Gall. Pott. Qua. Pin.
small Measure.	One Bushel of water measure is	5=10=20=40=80
	One Bushel of land measure is	4= 8=16=32=64
	One Peck is	1= 2= 4= 8=16
	One Gallon is	1= 2= 4= 8
	One Pottle is	1= 2= 4
	One Quart is	1= 2

The Table of Equation for liquid measure.

	Gall.	Pot.	Quar.	Pints	Pints	Pin.
A Firkin of Ale	8 =	16 =	32 =	64 =	128 =	256
A Firkin of Beer	9 =	18 =	36 =	72 =	144 =	288
A Kilderkin of Ale	16 =	32 =	64 =	128 =	256 =	512
A Barrel of Ale	32 =	64 =	128 =	256 =	512 =	1024
A Kilderkin of Beer, or Runlet of Wine	18 =	36 =	72 =	144 =	288 =	576
A Barrel of Beer, or two Runlets of Wine	36 =	72 =	144 =	288 =	576 =	1152
A Hoghead of Wine	63 =	126 =	252 =	504 =	1008 =	2016
A Tercion of Wine	84 =	168 =	336 =	672 =	1344 =	2688
A But or Pipe of Wine	126 =	252 =	504 =	1008 =	2016 =	4032
A Tun of Wine	252 =	504 =	1008 =	2016 =	4032 =	8064
A Tun of Sweet Oyl	236 =	472 =	944 =	8888 =	3776 =	7552

The Table of Equation for long Meaſure.

	Miles	Furl.	Perch.	Yards	Feet	Inches	Grains.
One League is	3 =	24 =	960 =	5971 1/4			
One Mile is	1 =	8 =	340 =	1760 =	5280 =	63360 =	190080
One Furlong is		1 =	40 =	220 =	660 =	7920 =	23760
One Perch, Rod, or Pole is			1 =	5 1/2 =	16 1/2 =	198 =	594
One Acre is of ſquare Perch			160 =	880 =	2640 =	792 =	2376
Or one Acre is { in length			40 =	220 =	660 =	7920 =	23760
Or one Acre is { in bredth			4 =	22 =	66 =	792 =	2376
One Rood, or 1/4 of an Acre is { in length			40 =				
One Rood, or 1/4 of an Acre is { in bredth			1 =	5 1/2 =	16 1/2		
One Fadom is					6 =	72 =	216
One Engliſh Elne is					3 1/4 =	45 =	135
One Yard is					3 =	36 =	108
One Foot is					1 =	12 =	36
One Inch is						1 =	3

The Table of Equation for Time.

	Mon.	Week.	Day.	Hou.	Min.
One Year hath	13 =	52 =	365 =	8760 =	525960
One Month hath	1 =	4 =	28 =	671 =	40320
One Week hath		1 =	7 =	168 =	10080
One Day naturally			1 =	24 =	1440
One Hour hath				1 =	60

The

The Table of Equation for Motion.

	Signs	*deg.*	*min.*	*″*	*‴*
Note that the	12 =	360 =	21600 =	129600 =	7776000
One Sign is	1 =	30 =	1800 =	108000 =	3648000
One Degree is		1 =	60 =	3600 =	216000
One Minute is			1 =	60 =	3600

CHAP.

CHAP. VII.

The RULE of THREE Direct.

Commonly called

The GOLDEN RULE.

OF all the Rules in Vulgar Arithmetick, this is the chief, though it wholly depends upon the two Rules before taught, *viz. Multiplication*, and *Division*. And of this Rule, the most which follow do participate, for it teacheth how, by having three numbers given, to find a fourth, which shall be in proportion to them.

Of this Rule there are two kinds, the one called the *Forward* or *Direct* Rule, the other the *Reverse* or *Backward* Rule of Three, in either of which, three things or Numbers are given, to find a fourth.

To work the forward or direct Rule of Three, these things are to be considered.

First, That the first and third of the numbers given, be both of one denomination or name. As for Example; if your first number be *Pounds*, and your third number be

Pounds alſo, then they be both of one d
mination; but if your firſt be *Ells*, and
third number any thing elſe but *Ells*,
Yards or the like) then they are of diff
denominations, but [by *Reduction*] mu
brought into one denomination; as if
firſt number be Ells, and your third nu
Yards, you muſt firſt turn your Ells
Quarters, and then your Yards into qu
alſo, and then your firſt and third nu
will be both quarters, and ſo of one de
nation.

Secondly, That of what name or de
nation your ſecond number is, of the
denomination muſt the fourth number(
is that you ſeek) be of alſo; as if the
be *Pounds*, the fourth muſt be *Pounds*
if the ſecond be *Yards*, the fourth
Yards alſo.

Thirdly, That in this Rule direct you
multiply the ſecond and third terms or
bers together, and the product of them
muſt divide by the firſt, the quotie
which diviſion will be the fourth numb
quired, and be of the ſame denomin
with the ſecond number given. To
form which work, this is

The RULE.

Multiply the ſecond term [*or number*]

third, and divide the product by the first, the quotient shall be the fourth number desired.

In the working of this Rule, the chief thing is to know how to place the three numbers aright, when they are promiscuously or confusedly given; but by what hath been said already, you may remember that two of them are always of one denomination, as both pounds, or both Ells, or both Yards or Feet, &c. and the other number hath another denomination, and this single denomination is ever the second number in order and one of the other two, namely, that which hath some relation to this second, is the first; and the other is the third number, whose relation is sought for in the fourth, whence it's plain, that the second and fourth are also of the same denomination.

Thus having premised these things, let us now exemplify the Rule in some Questions.

Question 1.

If 6 Yards of Cloth cost 8 *l.* what shall 42 Yards cost?

Set the numbers in order as in the Example following; If 6 yards cost 8 *l.* what 42 yards? Here you see that the first number and the third number are both of one denomination,

mination, *viz.* both *Yards*, and the seco number is of another denomination, nam *Pounds*, wherefore the fourth number, whi is ſought for, muſt be alſo *Pounds*; there fore multiplying the ſecond number by t third, and dividing the Product by t firſt, the quotient ſhall anſwer the qu ſtion.

Firſt, 42 multiplied by 8 produceth 33 which divided by 6 (the firſt number) t quotient is 56 *l.* and ſo much ſhall 42 Ya coſt. Your work being finiſhed, it will ſta thus:

Yards		*Pounds*		*Yards*
If 6	coſt	8	what	42

8

336

3

336 (56

06

Queſtion 2.

If 2 Ells coſt 16 *l.* what are 537 worth?

Place your numbers as here you see; then multiply 537 by 16 (that is, the second number by the third) and the Product is 8592.

Ells	*lib.*	*Ells*
2	16	537
		16
		3222
		537
		8592

x x
8592 (4296 *lib.*
x x x x

Which divided by 2 (the first number) the quotient is 4296, which is 4296 *l.* and so much are 537 Ells worth.

Question 3.

If 20 Sheep cost 13 pound, 13 shillings 4 pence, what is that a piece?

Turn the shillings and pounds into pence by Reduction thus:

sh.	*l.*
13	13
12	240
26	520
13	26
156	3120
	156
	4
	3280

Multiply 13 *s.* by 12, the Product is 15
And 13 *l.* by 240 (becauſe 240 *d.* maketh 1 *l.*) the Product is 312
To which add the 4 *d.*
It makes in all 3284

Then the Queſtion will be, If 20 Sheep coſt 3280 *d.* what ſhall one Sheep coſt?

ſheep		*pence*		*ſheep.*
If 20	coſt	3280	what	1

x d.

x *d.*
3280 164
xxxx

4 (8 *s.*
x64 (13
xxx
x

By the Rule before delivered, I ſhou multiply the ſecond number by the third, t in this Example, the third number being it doth not multiply; I therefore div 3280 the ſecond number, by 20 the f number, and the quotient 164, is the pr of one Sheep in pence, which divided 12, the quotient is 13 *ſ.* and 8 *d.* remai ing, the price of every ſingle Sheep there is 13 *ſ.* 8 *d.*

Qua

Question 4.

If 100 *l.* give 6 *l.* Interest for a Year, how much shall 750 *l.* give?

Multiply 750 by 6, the Product is 4500, which divided by 100, the quotient is 45 *l.* for the thing required.

l.		*l.*		*l.*
If 100	give	6	what	750
				6
				4500

4500 (45 *l.*
400

Question 5.

If 750 *l.* give 45 *l.* interest for a year, what shall 100 *l.* give?

Multiply 45 by 100, the product is 4500, which divided by 750, the quotient is 6 *l.* for the interest of 100 *l.* for a year.

l.		*l.*		*l.*
If 750	give	45	what	100
		100		
		4500		

3
4500 (6 *l.*
750

Many

Many other queſtions might be added, but the Rule is ſo plain that it needs them not; and ſo general, that he which can reſolve one, may as well reſolve any other. However I have here added other Examples for the Learner to practiſe by.

If 25 Yards of Cloth coſt 9 *l.* 12 *ſ.* what are 27 Ells worth?

Yards		*l.*	*ſ.*		*Yards.*
If 25	coſt	9	12	what	27
		20			
		192			

If 15 Ells of Cloth coſt 7 *l.* 10 *ſ.* what ſhall 27 Ells coſt?

Ells	*l.*	*ſ.*	*Ells*
15	7	10	27
	20		
	150		
	27		
	1050		
	300		
	4050	20	1
		4050	(270 *ſ.* or
			13 *l.* 10 *ſ.*

If 27 Ells cost 13 *l.* 10 *s.* what will 15 Ells cost?

Ells	*l.*	*s.*	*Ells*
27	13	10	15
	20		
	270		
	15		
	1350		
	270		
	4050		

~~1~~
~~23~~ 1
~~4050~~ (15|0
~~2777~~ 7 *l.* 10 *s.*
~~22~~

If 27 Ells cost 13 *l.* 10 *s.* how many Ells shall I have for 7 *l.* 10 *s*?

l.	*s.*	*Ells*	*l.*	*s.*
13	10	27	7	10
20		7		
270			150	
			27	
~~13~~			1050	
~~23~~			300	
~~4050~~ (15			4050	
~~2700~~				
~~27~~				

If

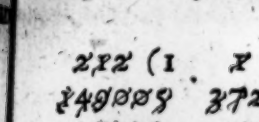
If I sell 15 Ells for 17 *l.* 10 *s.* how many Ells shall I sell for 13 *l.* 10 *s.*

l.	*s.*	*Ells*	*l.*	*s.*
7	10	15	13	10
20			20	
150			270	
			15	
			1350	
			260	
			4050	

~~13~~
~~20~~
~~4050~~ (27
~~1500~~
~~15~~

If 4 pounds cost 1 *s.* 5 *d.* what will 8765 pound cost?

l.	*s.*	*d.*	*lib.*
4	1	5	8765
	12		17
	17		61355
			8765
			149005



Anſ. 155 *l.* 4 *ſ.* 3 ¼ *d.*

If 15 Ells coſt 7 *l.* 10 *ſ.* what are 27 ½ Ells worth?

Here becauſe there are half Ells in the Queſtion, you muſt therefore turn your 15 Ells into halves, by multiplying them by 2, and they make 30 half Ells; alſo you muſt turn your 27 Ells and a half, into halves, and they make 55 half Ells: then will the work ſtand as here you ſee.

Ells	*l.*	*ſ.*	*Ells*
15	7	10	27 ½
2	20		2
30	150		55
	55		
	750		
	750		
	8250		

2,1 1
8250 (27|5
3000 13
33

Anſ. 13 *l.* 15 *ſh.*

If 27 Ells and $\frac{1}{3}$ coſt 13 *l.* 15 *s.* what is 15 Ells worth?

Ells	*l.*	*s.*	*Ells*
$27\frac{1}{3}$	13	15	15
2	20		2
55	275		30
	30		
	8250		
	22		
	37	1	
	8250	(15|0	
	5555	7	
	55		

CHAP

CHAP. VIII.

The RULE *of* THREE, *Reverse.*

Or, The Backward

GOLDEN RULE.

SOme there are that make no difference between the *Direct* and the *Reverse Rule* of *Three*, but onely in stating of the Question, and placing of the Numbers: But as in the *Direct Rule* you multiplied the second and third numbers together, and divided the Product by the first: in this *Reverse* you must

Multiply the First Number by the second, and divide the Product by the third, the quotient shall be the Fourth Number required, and be (as in the Direct Rule) of the same Denomination with the second Number.

Objection.

But here it may be questioned, How shall I know when a Question is propounded, whether it must be wrought by the *forward* or the *backward* Rule?

Answer.

Answer.

This General Rule is to be observed, more *require* more, *or if* less *require* less *the Question must be wrought by the* forward *Rule.*

But, *If* more *require* less, *or* less *require* more, *then must you use the* reverse *or* backward *Rule.*

The Examples following will make this plain.

Question.

If 24 Pioneers require 16 months to dig a Trench or Ditch about a City, how many Pioneers must there be employed to dig the like Trench or Ditch in 4 Months time?

Here 24 is not the first number, though first named; but the three numbers placed in order, stand thus:

16 24 4

For the middle term must always be of the same denomination with that which is required, as in the Rule of Three direct.

Now multiply 24 by 16, the Product is 384, which divided by 4, the quotient is 96, and so many Pioneers must be employed to dig the Trench in four Months.

Mon.	*Men*	*Months*
16	24	4
	16	
	144	2
	24	384 (96
	384	44

For if 16 Months require 24 Men; then (a fourth part of 16, which is) 4 Months shall require (four times 24, that is) 96 Men.

For here, *less* requires *more*, that is, *less time*, *more hands*; and therefore is it wrought by the *reverse Rule*.

Question 2.

If 1 Close would graze 21 Horses 6 Weeks, how many Horses would it feed for 7 Weeks?

Multiply 21 by 6 it produceth 126, which divided by 7, the quotient is 18. At that rate therefore it would keep 18 Horses for 7 Weeks.

Weeks	*Horses*	*Weeks.*
6	21	7
	6	
	126	8
		126 (18
		77

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Que-

Question 3.

If one Close will feed 18 Horses for 7 Weeks, how long shall it feed 63 Horses?

Multiply (according to the Rule) 18 by 7, the Product is 126, which divided by 63, the quotient is 2, therefore two Weeks it shall keep them.

Horses	*Weeks*	*Horses*
18	7	63
7		
126		

126 (2
63

This Rule serves indifferently for Hay, Oats, or any other Provision for Man or Beast, which may be of use in Garrisons, and such like cases where scarcity may be feared, to proportion either the *mouths* to the *meat*, or the *meat* to the *mouths*.

I will say no more of this Rule, only give you three or four Examples for Practice.

Other Examples for Practice.

One lent his Friend 400 *l.* without interest for 7 months; the Question is, how much he ought to lend him for twelve months, to requite his courtesie?

Month

Months	*l.*	*Months*
7	400	12
	7	
	2800	

	l.	*ſ.*	*d.*
44(4			
28 (233	6	8	

One lent his Friend 233 *l.* 6 *ſ.* 8 *d.* for 12 months without intereſt, upon condition he ſhould upon occaſion do him the like pleaſure; the Queſtion is, how much he ought to lend for 7 months to requite his Courteſie?

Months	*l.*	*ſ.*	*d.*	*Months.*
12	233	6	8	7
	20			
	4666			
	12			
	9340			
	4666			
	56000			
	12			
	112000			
	56000			
	672000			

4 x
672000 (96000 (8000
777777 xxxxx
xxx

Anſ. 400 *l.*

One lent his Friend 400 *l.* for 7 months, upon condition that he ſhould do the like for him; but when he came to borrow of him, he could lend him but 233 *l.* 6 *s.* 8 *d.* how long ought he to keep it to ſave himſelf harmleſs?

l.	*Month*	*l.*	*s.*	*d.*
400	7	233	6	8
20		20		
8000		4666		
12		12		
16000		9340		
8000		4666		
96000		56000		
7				
672000				

x
xx
672000 (12 *Months*
56000
5600

One lent his Friend 233 *l.* 6 *s.* 8 *d.* for 2 months, how long ought he to lend him 400 *l.* to save him harmless?

l.	*s.*	*d.*	*Months*	*l.*
233	6	8	12	400
20				20
4666				8000
12				12
9340				16000
4666				8000
56000				96000
12				
112000				
56000				
672000				

4

672000 (7 Months.

96000

CHAP.

CHAP. IX.

The Golden Rule, *compounded of five Numbers: Commonly called,* The Double RULE *of* THREE.

THis Rule is an abbreviation of the common Rule of Three Numbers, for that it performeth that at one working, which the other Rule of Three effecteth at twice.

When any queſtion appertaining to this Rule is propoſed, you muſt firſt diſpoſe the five Numbers in ſuch ſort, that the *ſecond* number and the *fifth* be of the ſame denomination, and that the *third* or *middle* number of the five, be of the ſame denomination with that which is ſought.

The Numbers being thus diſpoſed, you muſt work by this following Direction.

The RULE.

Multiply the firſt and ſecond Numbers together, the Product of them ſhall be your Diviſor. Again, multiply the three laſt Numbers one by another, (that is) the third by the fourth, and the fourth by the fifth, that

Product shall be your Dividend; *and the Number produced by that Division shall answer the Question, and be of the same denomination with the third, or middle, Number.*

Question 1.

If 6 men in 2 Weeks build 23 Rod of Wall, how many Rod will 24 Men build in 12 Weeks?

First place your Numbers as here is done, where you may see that the second Number and the fifth are of the same denomination, *viz.* both *Weeks*; and that the third or middle Number is *Roods*, of which denomination must the Number sought be.

Men	*Weeks*	*Rod*	*Men*	*Weeks*
6	2	23	24	12
	6		23	
	12		72	
			48	
			552	
			12	
			1104	
			552	
			6624	

6624 (552 *Rod*

Your Numbers being placed as you h
ſee, multiply 6 by 2, it makes 12 for y
Diviſor. Then multiply 23 by 24, and
maketh 552, that again multiplied by
(the fifth Number) produceth 6624 for y
Dividend.

Laſtly, Divide 6624 by 12, and the Q
tient will be 552; and ſo many Rod of
like Wall will 24 Men build in 12 Week

Queſtion 2.

If a Hundred weight (that is, 11
weight) carried 120 miles, coſt 14 s.
much ſhall three quarters of a hundred (
is, 84 pound) coſt, being carried 40 mi

Firſt, place your numbers according to
tenor of the Queſtion thus:

l.	*Miles*	*ſ.*	*l.*	*Miles*
112	120	14	84	40
120		12		
2240		28		
112		14		
13440		168	pence	
		84		
		672		
		1344		
		14112		
		40		
		564480		

x8
x488
564480 (42
x13440
x344

Your numbers being placed in order, reduce the 14 s. into pence, and it is 168 pence, then multiply 168 by 84, the Product is 14112, which multiplied by 40, (the last number) it produceth 564480, for the Dividend.

Then multiply 112 by 120, it produceth 13440, for the Divisor.

Divide 564480 by 13440, the Quotient will be 42 pence, which is 3 s. 6 d. and answers the Question.

Thus in this Rule you may observe, that the first number and fourth, the second and fifth, and also the third and sixth are of like denominations.

Question 3.

If 100 *l.* for 6 Months yield 3 *l.* interest, what shall 625 pound yield for 36 Months?

Multiply the three last, as before is shewed, the later Product is 67500, for the Dividend. And the two first numbers multiplied make 600 the Divisor; then divide

67500 by 600, or 675 by 6, which is one) the quotient will be 112 whole pound and 300 (or 3) remaining, which beca it is half the Diviſor, ſignifies the half o pound, that is, 10 *s.* So the anſwer to t queſtion is 112 *l.* 10 *s.*

l.	*m.*	*l.*	*m.*
100	6	625	36
6		3	
600		1875	
		36	
		11250	
		5625	
		67500	

Which might have been given in one nomination, namely, 2250 ſhillings, if before the work, the pounds had been tur into ſhillings, by multiplying them by 20 hath been ſhewed before.

But ſince moſt queſtions, except ſuch are deſigned for the purpoſe, are apt to in ſome Fractions, I ſhall next treat of Fr ctions.

Only take notice, that all queſtions whi are wrought at once by this compound R of five Numbers, may be done at twice the ſingle Rule of Three; and the doing

them ſo by two operations, is called the Double Rule of Three.

As in our laſt queſtion there are two things conſiderable, the money, and the time.

Firſt, for the money.

Say, if 100 *l.* give 3 *l.* what 625 *l.* anſwer, 18 $\frac{75}{100}$ *l.*

Secondly, for the time.

Say, if 6 *mo.* give 18 $\frac{75}{100}$ *l.* what 36 *mo.* anſwer, 112 $\frac{50}{100}$ *l.*

But this will be better underſtood, when Fractions are learned, which now we come to teach.

CHAP. X.

Of FRACTIONS.

A Fraction is the part of any entire thing as when any thing is broken or divided into parts, thoſe parts are called Fractions; as if a Pound in money be broken or divided into ſhillings, 17 *s.* is ſeventeen twenties of a pound, alſo 10 *s.* is ten twenties of a pound. Likewiſe if a ſhilling be the integer, then pence are the Fraction parts thereof; as 7 pence is ſeven twelfths of a ſhilling, 5 pence is five twelfths of a ſhilling, and ſo of any other number of pence. Alſo if a penny be the integer, then farthings are the Fraction parts thereof; as 3 farthings is three fourths of a penny, 2 farthings is two fourths of a penny, and one farthing is the one fourth of a penny.

And the like is to be underſtood of any other thing that may be parted, as of Weight into Pounds, Ounces and Drams; or of Meaſure into Buſhels, Pecks, Gallons, Quarts *&c.* Or any other thing that may be broken into parts.

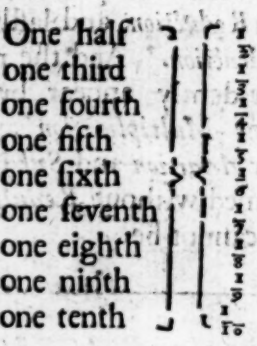
In Fractions we will begin firſt with Numeration

meration, then with *Multiplication* and *Divi-*
sion, then with *Reduction*, and laſtly with *Ad-*
dition and *Subſtraction*. And the reaſon why
I ſo do, will evidently appear by the work
following; for *Multiplication* and *Diviſion*
are eaſier than *Addition* and *Subſtraction*, and
may be performed without *Reduction*, which
the other two cannot be.

Numeration of FRACTIONS.

NUmeration of Fractions teacheth how to write any Fraction down, and alſo how to expreſs any Fraction that is already written; and that this may be done, we muſt conſider, that any Unite or Number repreſenting an Unite, may be broken into two parts equal, and then each of the parts is called *one half*; or it may be parted into three equal parts, and then each part is called *one third*; and two of them are called *two thirds*: and the like may be underſtood if the unite were parted into 4, 5, 6, 7, 8, 9, 20, 50, or 100, or how many ſoever parts.

Now to write theſe, do thus:



In every one of these nine Fractions, the Number below the line is called the *Denominator*, and it shews into how many parts the unite is broken.

The Number above the line shews how many of those parts are taken, or contained in the Fraction, and is thence called the *Numerator*: So in the Fraction $\frac{3}{5}$ the Denominator 5 shews the unite to be broken into 5 parts, and the Numerator 3, signifies 3 of those parts to be contained in the Fraction, which Fraction therefore is called *three fifths*.

So that all Fractions are quotients of lesser numbers divided by greater, as $\frac{4}{7}$ signifies 4 to be divided by 7; and the line of separation which is drawn between the 4 and the 7, doth properly signifie Division.

Hitherto we have spoken only of such Fractions as are less than 1, which are called *Proper*

Proper Fractions: But there are alſo $2\frac{1}{3}$, $3\frac{3}{4}$, $5\frac{1}{7}$, $6\frac{3}{5}$, and the like, and theſe are called mixed Numbers, which ſo written ſignify *two and an half, three and three quarters, five and a ſeventh, ſix and three fifths.* Theſe by multiplying Numbers by the Denominator, and to the Product adding the Numerators reſpectively, are turned to $\frac{5}{2}$, $\frac{15}{4}$, $\frac{36}{7}$, $\frac{33}{5}$, which are called *Improper Fractions*, becauſe every one of them contains more than unity.

Theſe nevertheleſs may be multiplied, divided, added or ſubſtracted in the ſame way as proper Fractions are.

Multiplication of FRACTIONS.

ALL proper Fractions (which are all Fractions leſs than One) are ſtill made leſs by multiplying; and for Multiplication this is

The RULE.

Multiply all the Numerators together, the laſt Product ſhall be the Numerator of the Product required; Likewiſe multiply all the Denominators together, the laſt Product ſhall be the Denominator of the Product ſought.

Example 1.

If $\frac{3}{5}$ be to be multiplied by $\frac{4}{9}$, multiply the Numerator 3 by the Numerator 4, the Product is 12, for the Numerator of the new Product. Also multiplying the Denominator 5, by the Denominator 9, they produce 45 for the Denominator of the desired Product, so that the Product which was required is $\frac{12}{45}$.

Example 2.

If $\frac{1}{2}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{3}$, and $\frac{3}{11}$, were to be multiplied altogether, begin with the Numerators, saying, once 3 is 3, and 3 times 4 is 12, and 12 times 5 is 60, and 60 times 3 is 180 for the Numerator: Then multiply the Denominators, saying, 2 times 4 is 8, and 8 times 5 is 40, and 40 times 9 is 360, and 360 times 11 is 3960 for the new Denominator. So that the Product of all these is $\frac{180}{3960}$.

Example 3.

To multiply the mixt Numbers, $3\frac{1}{2}$, and $5\frac{3}{4}$: First (as hath been shewn already) turn them into improper Fractions, thus, first say 2 times

2 times 3 is 6 and 1 is 7. So the first is $\frac{7}{2}$, Secondly, 3 times 4 is 12 and 1 is 13. So the second is $\frac{13}{3}$. Lastly, 4 times 5 is 20, and 3 is 23. So the last is $\frac{23}{4}$. Now the Fractions to be multiplied are $\frac{7}{2}$, $\frac{13}{3}$, and $\frac{23}{4}$. First, for a new Numerator, say, 7 times 13 is 91; and 91 times 23 is 2093, for a new Numerator.

Then say, 2 times 3 is 6, and 6 times 4 is 24. So the new Denominator is 24.

And the Product of all these Fractions is $\frac{2093}{24}$, that is, if real Division be made, $87\frac{5}{24}$.

Division of FRACTIONS.

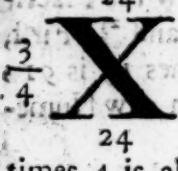
DIvision of one Fraction by another, is but the cross multiplying of them, for which this is

The RULE.

Multiply the Numerator of the one, by the Denominator of the other, and hereby the proportion of one Fraction to another is seen.

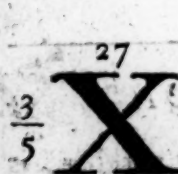
Example

Example 1.



Divide $\frac{3}{4}$ by $\frac{6}{8}$, to do set them thus: and multiply as the Croſs leads, ſaying, 3 times 8 is 24, for new Numerator, and times 4 is alſo 24 for a new Denominator. So the quotient is $\frac{24}{24}$, that is 1, which ſhews the Fractions to be equal one to another.

Example 2.



Divide $\frac{3}{5}$ by $\frac{4}{9}$. First, ſ them thus, and ſay, 3 tim 9 is 27, for a Numerator And 5 times 4 is 20, f the Denominator. So t quotient is $\frac{27}{20}$, and ſo many times is $\frac{4}{9}$ co tained in $\frac{3}{5}$.

In Diviſion it is to be remembred, th the *Numerator* of the quotient ever ariſe of the Numerator of the *Dividend*; and t *Denominator* of the quotient comes of t Denominator of the *Dividend*, each be croſs multiplied, as before.

If a Fraction be to be divided by a wh Number, multiply the denominator by th Number, the Product gives the new deno nat

nator, and the Numerator remains the same. So if $\frac{1}{4}$ be divided by 9, say 9 times 4 is 36. So the quotient is $\frac{1}{36}$.

Or if $\frac{1}{4}$ were to be multiplied by 9, the Product (by multiplying the Numerator by 9) will be $\frac{9}{4}$, that is, $2\frac{1}{4}$.

Example 3.

$$\frac{320}{8} \times \frac{45}{9} = \frac{2880}{360}$$

Divide $\frac{320}{8}$ by $\frac{45}{9}$, thus, say 320 times 9 is 2880 for a Numerator; and 8 times 45 is 360 for a denominator. So the Quotient is $\frac{2880}{360}$.

Reduction of FRACTIONS.

OF Reduction of Fractions there are three varieties.

1. To reduce a Fraction to a lesser denomination.

2. To reduce many Fractions of divers denominations, to one denomination.

3. To reduce any Fraction from one denomination (as near as may be) to any other denomination desired.

For the first of these, this is

The

The RULE.

Divide both the Numerator and the Denominator by the greateſt common Diviſor that you can think of, the two quotients being placed reſpectively in a Fraction, that Fraction ſhall be equal to the former Fraction, and in leſſer terms.

So (in the third Example of Diviſion) to reduce $\frac{2880}{3600}$ to $\frac{8}{10}$, divide 2880 by 360, the quotient is 8; then divide 360 by 360, the quotient is 1, and the new Fraction $\frac{8}{10}$ is equal to the former Fraction, $\frac{2880}{3600}$, and in leſs terms as you may ſee. But to find the greateſt common Diviſor, this is

The RULE.

Divide the greater term by the leſſer, (I mean by terms, the Numerator and Denominator) *and by the remainder (if any be) divide the Diviſor, and if any thing ſtill remains, by that divide the laſt Diviſor, continuing this courſe till nothing remain greater than unity, that Diviſor which is laſt of all, is the greateſt common meaſure of both terms by which, both Numerator and Denominator being divided, and the quotients placed like a Fraction,*

that

that Fraction shall be equal to the former Fraction, and in the least terms.

Example.

Reduce $\frac{148}{16}$ to the least terms; first divide 148 by 16, the quotient is 9, and 4 remains: again divide 16 by 4, the quotient is 4, and nothing remains; wherefore taking 4, (the last Divisor) for the greatest common Divisor, by it divide 148, the quotient is 37, and by it divide 16, the quotient is 4. These two last quotients placed orderly in a Fraction, make $\frac{37}{4}$, which is equal to $\frac{148}{16}$, and in the least terms; for no number greater than 1, will divide evenly both 37 and 4.

Now secondly, to reduce many Denominations to one common Denominator; let the Fractions be $\frac{1}{2}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{7}{8}$, $\frac{9}{10}$, to be reduced all to the Denomination 3200.

The RULE.

Multiply all the Denominators together, saying 2 *times* 4 *is* 8, *and* 8 *times* 5 *is* 40, *and* 40 *times* 8 *is* 320, *and* 320 *times* 10 *is* 3200; *this last Product* 3200, *shall be the common Denominators.* Then to get Numerators for every one of them: *Multiply every particular*

particular Numerator into all the Denominators except his own. As first, for the first, say once 4 is 4, and 4 times 5 is 20, and 20 times 8 is 160, and 160 times 10 is 1600.

For the first Numerator: So the first Fraction reduced is $\frac{1600}{3200}$. Then for the second Numerator, say, 3 times 2 is 6, and 6 times 5 is 30, and 30 times 8 is 240, and 240 times 10 is 2400. So the second Fraction reduced, is $\frac{2400}{3200}$. After the same manner may the other three be reduced to $\frac{2400}{3200}$ or the third; $\frac{2800}{3200}$ for the fourth; and $\frac{2880}{3200}$ for the last. These are severally equal to the other, the first to the first, *&c.* as may be proved thus,

Let the unite be a pound *Sterl.* then

		s.	
The $\frac{1}{2}$ of it is		10	
and $\frac{3}{4}$ is		15	
and $\frac{4}{5}$ is		16	
and $\frac{7}{8}$ is		17	6 *d.*
and $\frac{9}{10}$ is		18	
In all		66 *s.*	6 *d.*

That is, 3 whole unites, and 16 *s.* and 6 *d.* over. Turn 16 *s.* 6 *d.* all to six pences, it is 33, and because 6 *d.* is the fortieth part

of a pound, therefore all the Fractions are equal to $3\frac{33}{40}$.

Now add the new Fractions which (being all of one denomination) may be added like whole Numbers, thus:

1600
2400
2560
2800
2880
In all 12240

Which divided by the Denominator 3200 the quotient is $3\frac{1640}{3200}$. Now $\frac{1640}{3200}$ reduced to the least terms, as hath been shewed how it may, will be $\frac{33}{40}$, so the summ of these also is $3\frac{33}{40}$, which is equal to the summ of the Fractions given to be reduced, and therefore they are equal in summ, and might be thus proved equal severally, that is, the first of them propounded, to the first reduced. Divide the Numerator 1600 by the Numerator 1, the quotient is 1600. Also divide the Denominator 3200, by the Denominator 2, the quotient is also 1600, and so may any of the rest be proved equal by the equality of quotients.

Thirdly, Any Fraction being given, to change the Denomination to any other more requisite,

requiſite, retaining ſtill (as near as may be) the ſame value.

The RULE.

Multiply the Numerator given, by the Denominator required, and divide the Product by the Denominator given, the quotient ſhall be the Numerator required.

Example.

Let the Fraction given be $\frac{7}{13}$ of a pound *Sterling*, what is that in twenty parts of ſhillings? Multiply 7 by 20, the Product is 140, which divided by 13, the quotient is $10\frac{10}{13}$, that is, 10 *s.* and $\frac{10}{13}$ of a ſhilling, which may be brought to pence thus, multiply 10 by 12, the Product is 120, which divide by 13, the quotient $9\frac{3}{13}$ *d.* And again, multiply 3 by 4, the Product is 12, which divided by 13, the quotient is $\frac{12}{13}$ of a farthing, ſo ſeven thirteenths of a pound is 10 *s.* 9 *d.* and almoſt a farthing.

Fractions of Fractions.

In the Reduction of Fractions, ſome mention another, or more parts, as Fractions of Fractions

tions for one; that is, when there is a part of a Fraction, or part of a part of a Fraction, &c. to be valued in one Fraction.

The RULE.

Multiply all the Numerators together, the last Product shall be the Numerator desired: then multiply all the Denominators together, and this last Product shall be the Denominator sought.

Example.

Let the Fractions of Fractions propounded, be $\frac{4}{5}$ of $\frac{3}{4}$ of $\frac{1}{2}$, for so they are usually written; and let the Numerators be multiplyed, saying, 4 times 3 is 12, and 12 times 1 is 12, the Numerator therefore required is 12; then for the Denominator, say, 5 times 4 is 20, and 20 times 2 is 40, for the Denominator required; and $\frac{12}{40}$ is equal to $\frac{4}{5}$ of $\frac{3}{4}$ of $\frac{1}{2}$.

Proof.

Let the Unite be 40 *s.* one fifth of 40 is 8, and there $\frac{4}{5}$ is 32, of which one fourth is 8, and $\frac{3}{4}$ is 24, of which one half is 12, and therefore $\frac{12}{40}$ is the just summ of all the

Fractions.

Fractions. This needs no further exemplifying.

Addition of FRACTIONS.

IN the adding of many Fractions into one summ, you are to consider whether they be of one Denomination or divers; if of one, then this is

The RULE.

Add all the Numerators together into a summ, that summ is the new Numerator: and the Denominator is the same. As for

Example.

Let the Fractions to be added be $\frac{1}{4}$, $\frac{2}{4}$, add the Numerators, saying, 2 and 1 is 6, and 6 and 5 is 11, and 11 and 1 is 12. So the summ of them all is $\frac{12}{4}$, that is 3 Unites.

As, let the Unite be 20 *s.* one fourth is 5 *s.* and $\frac{2}{4}$ is 10 *s.* and $\frac{4}{4}$ is 20 *s.* which added to 10 *s.* is 30 *s.* then $\frac{3}{4}$ is 25 *s.* which added to the thirty shillings gives 55 *s.* And lastly, $\frac{1}{4}$ is 5 *s.* which added to 55 *s.* makes 60 *s.* that is 3 times 20 *s.* that is 3 *l.* or 3 Unites.

B

But if the Fractions to be added, be of divers denominations, as let them be $\frac{3}{5}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{7}{8}$, then (by the reduction afore going) they muſt be turned all into one denomination, and then they will be $\frac{320}{480}$, $\frac{360}{480}$, $\frac{384}{480}$, and $\frac{480}{480}$, and may be added like thoſe before, thus:

320
360
384
420
In all, 1484

So the ſumm of all is $\frac{1484}{480}$, or $\frac{371}{120}$, that is $3\frac{31}{120}$, which if it be money, and the Unite 1 *l.* it is then 3 *l.* 1 *s.* and 10 *d.* as may be tryed thus. Firſt, $\frac{2}{5}$ of a pound, is 13 *s.* and 4 *d.* and $\frac{3}{4}$ is 15 *s.* and $\frac{4}{5}$ is 16 *s.* Laſtly, $\frac{7}{8}$ is 17 *s.* 6 *d.* Theſe all added together, the ſumm is 3 *l.* 1 *s.* 10 *d.*

	l.	*s.*	*d.*
$\frac{2}{5}$ of a pound is	0	13	4
$\frac{3}{4}$ of a pound is	0	15	0
$\frac{4}{5}$ of a pound is	0	16	0
$\frac{7}{8}$ of a pound is	0	17	6
In all	3	1	10

Subſtractions

Substractions of FRACTIONS.

IN Substracting of one Fraction from another, if they be both of one denomination, this is

The RULE.

Take the Numerator of one from the Numerator of the other, the remain is the Numerator, and the Denominator the same before.

So if $\frac{2}{3}$ be substracted from $\frac{5}{3}$, the rem is $\frac{3}{3}$, the like of all others.

But if they be not of one Denomina they must first be reduced to be so, and the substraction is the same as before.

The Golden Rule in Fractions is the sa as in whole Numbers, I will give you one instance here by the way, and Exemp it in the Rule it self, both direct and reve in the two next Chapters.

If $\frac{3}{4}$ of a Yard of Tape, cost $\frac{1}{5}$ of a pen what shall one inch, that is $\frac{1}{36}$ of a Y cost?

Multiply the second by the third, the Pr duct is $\frac{1}{15}$, which divided by $\frac{3}{4}$, the quotie

$\frac{4}{176}$ of a penny, for the price of $\frac{1}{7}$ of a Yard.

Otherwise.

Seeing $\frac{1}{4}$ of a Yard may be turned into 7 Inches; Say, if 27 cost $\frac{1}{3}$, what 1? divide $\frac{1}{3}$ by 27, it makes $\frac{1}{81}$ for the answer, which is equal to $\frac{4}{176}$, and in the least terms.

And whersoever this may be done, to have the first and third Numbers Fractions of one denomination, the best way is to work with their Numerators, not regarding their Denominators at all: as if $\frac{2}{3}$ cost $\frac{1}{4}$, what $\frac{7}{8}$? instead thereof write, if 2 cost $\frac{1}{4}$, what 7? multiply $\frac{1}{4}$ by 7, it produceth $\frac{21}{4}$, which divided by 2, the quotient is $\frac{21}{8}$, and that is the answer in the least terms.

And all this while it should have been noted, that Fractions are ever written in a smaller Figure than the whole Numbers.

How to Double, Triple, Quadruple any Fraction.

1. To Double
2. To Triple
3. To Quadruple
4. To Quindruple, *&c.*

} any Fraction, it is but to divide the same Fraction by } 2 3 4 5

The Proofs of Reduction, Multiplication, Diviſion, Addition, and Subſtraction of Fractions.

ALthough this be, in ſome meaſure, hi
ted at in the reſpective Rules, yet n
ſo obvious as the Learner thereby can di
ver it to be other than a particular pro
of the Examples there delivered. But
come to a General Proof of each Rule, w
will begin with

The Proof of Reduction.

ANY reduced Fraction being in the le
Terms, if you multiply the Numera
and Denominator thereof by the Gre
common Meaſure, you ſhall bring it to
former part or parts.

Thus in our firſt Example $\frac{148}{176}$ was reduc
to its leaſt Terms, and by that means ca
to $\frac{37}{44}$. Now if you multiply 37 the Nu
rator of this Fraction by 4, the comm
meaſure by which it was reduced, it w
produce 148, which was the Numerator
the Fraction before abbreviation was ma
and 4 multiplyed by 4 produceth 16 for
Denominator thereof before abbreviation

The Proof of Multiplication.

Divide the Product of your whole Multiplication by the Multiplier, and in your Quotient you shall have the number by which you multiplied. And if you divide by the Multiplicand, you shall have in the Quotient the Multiplicator.

Thus, $\frac{2}{3}$ multiplied by $\frac{4}{5}$ will produce $\frac{8}{15}$. Now if you divide $\frac{8}{15}$ by $\frac{4}{5}$, it will produce $\frac{40}{60}$ or $\frac{2}{3}$. And if you divide $\frac{8}{15}$ by $\frac{2}{3}$, you shall have $\frac{24}{30}$ or $\frac{4}{5}$.

The Proof of Division.

Multiply the Quotient produced by any Division, by the Divisor, and you shall have the number by which you did divide.

So $\frac{2}{3}$ being divided by $\frac{3}{4}$ will produce $\frac{8}{9}$ for the Quotient; which $\frac{8}{9}$ being multiplied by the Divisor $\frac{3}{4}$, it will produce $\frac{24}{36}$, which in the least Terms is $\frac{2}{3}$, which was the former Dividend.

The Proof of Addition.

Subſtract one Number or Numbers which you added, from the other Number or Numbers, and the remainer or remainers ſhall be equal to the other Number or Numbers.

Thus $\frac{1}{3}$ and $\frac{1}{4}$ being added together, will produce $\frac{7}{12}$. Now if from $\frac{7}{12}$ you ſubſtract $\frac{1}{3}$, there will remain $\frac{1}{4}$; or if from the other number $\frac{7}{12}$ you ſubſtract $\frac{1}{4}$, the remainer will be $\frac{1}{3}$.

The Proof of Subſtraction.

ADD the Number which you did ſubſtract, and the number which did remain together, and the ſumm ſhall be equal to the ſumm out of which you ſubſtracted the remainer. Or if you add the two leſſer numbers, you ſhall find the greater number.

If you ſubſtract $\frac{1}{4}$ from $\frac{2}{3}$, there will remain $\frac{1}{12}$. Now if you add $\frac{1}{12}$ and $\frac{1}{4}$ together, and they make $\frac{16}{48}$ or $\frac{1}{3}$, which is the greater of the Numbers. And let this ſuffice for the Proof Fractions.

CHA

CHAP. XI.

The Golden Rule, *or* Rule of Three, *Direct in Fractions.*

THE manner of working the Golden Rule in Fractions differs little from that in whole Numbers. As by the Examples in the former Chapter may appear: The manner of working of it is in general thus, and this is

The RULE.

Multiply the Numerator of the first Fraction by the Denominator of the second, and that by the Denominator of the third for your Divisor.

Again, *Multiply the Denominator of the first number, by the Numerator of the second, and that by the Numerator of the third, for your dividend.*

An Example or two will make it plain.

Question 1.

If $\frac{1}{4}$ of an Ell of Linnen Cloth cost $\frac{1}{2}$ of a Crown, what shall $\frac{1}{16}$ of an Ell cost?

Place the numbers as these following.

Ells	*Cr.*	*Ells*
$\frac{3}{4}$	$\frac{1}{3}$	$\frac{1}{36}$

By your Rule, Multiply 3, the Numerator of the first Fraction, by 2 the Denominator of the second Fraction, and it maketh 6 that multiply by 36, the Denominator of the third Fraction, produceth 216, which is your Divisor.

Again, Multiply 4 the Denominator of the first Fraction, by 1 the Numerator of the second, it is still 4, multiply by 1, the Numerator of the third, produceth still 4, for your Dividend; which being less than the Divisor, must be set thus $\frac{4}{216}$ of a Crown; so the price of $\frac{1}{36}$ of an Ell, which in the least terms is $\frac{1}{54}$. See the work.

Ells	*Cr.*	*Ells*
$\frac{3}{4}$	$\frac{1}{2}$	$\frac{1}{36}$
$\frac{2}{4}$	$\frac{3}{6}$	$\frac{6}{216}$
$\frac{1}{4}$		
	$\frac{4}{216}$	

Question 2.

If $\frac{7}{8}$ of an Ounce of Silver cost $\frac{4}{36}$ of a pound Sterling, what shall $\frac{3}{11}$ of an Ounce cost?

Answ. $\frac{208}{1820}$, or in lesser terms $\frac{27}{455}$. See the work.

ou.	*l.*	*ou.*
$\frac{7}{8}$	$\frac{4}{20}$	$\frac{3}{13}$
4	7	
36	140	
3	13	
108	420	
	140	
	1820	

Other Examples.

1. If $\frac{3}{4}$ of a Yard of Velvet, cost $\frac{2}{3}$ of a pound Sterling, what shall $\frac{5}{6}$ of a Yard cost?

ya.	*ou.*	*ya.*
$\frac{3}{4}$	$\frac{2}{3}$	$\frac{5}{6}$
2	3	
8	9	
5	6	*Answ.* $\frac{40}{54}$ or $\frac{7}{11}$
40	54	

2. If $\frac{11}{12}$ of an Ounce of Silver be worth $\frac{12}{4}$ of a Crown, what is $\frac{1}{2}$ worth?

ou.	*cr.*	*ou.*
$\frac{11}{12}$	$\frac{12}{4}$	$\frac{1}{2}$
12	11	
24	44	
12	2	
144	88	
1		
144		
(5		
88(6		
144 (1		
88		

Anſ. 1 $\frac{56}{88}$ or 1 $\frac{7}{11}$.

3. If $\frac{2}{3}$ of a Gallon of Wine be worth $\frac{4}{5}$ of 20 *ſh.* what is $\frac{7}{8}$ of a Gallon worth?

$\frac{2}{3}$	$\frac{4}{5}$	$\frac{7}{8}$
4	3	
12	12	
7	8	
84	80	*Anſw.* $\frac{84}{80}$ or 1 $\frac{4}{80}$.
$\frac{84}{80}$	That is, 1 *l.* 1 *ſ.*	

CHAP.

CHAP. XII.

The RULE *of* THREE *Reverse in* FRACTIONS.

IN this Rule you must go contrary to the former, as in whole numbers: For this is

The RULE.

Multiply the Numerator of the first Fraction, by the Numerator of the second Fraction, and the Product by the Denominator of the third, for your Dividend. *Then the Denominator of the first, by the Denominator of the second, and that by the Numerator of the third, for your* Divisor.

Question 1.

If when the price of a Quarter of Wheat is 2 *s.* the farthing white Loaf shall weigh 68 *s.* I demand then what such a Loaf shall weigh when the Quarter of Wheat is worth 3 *s.*

s.	s.	s.
$\frac{2}{20}$	$\frac{68}{20}$	$\frac{3}{20}$
68	20	
2	20	
136	400	
20	3	
2720	1200	

Answer, (3 *l.* *s.* *d.*
~~27~~(20 (2$\frac{32}{12}$, or 2 5 4.
~~1200~~

Question 2.

When the price of a Quarter of Wheat is 9 *s.* what shall the farthing white Loaf weigh?

s.	s.	s.
$\frac{2}{20}$	$\frac{68}{20}$	$\frac{9}{20}$
68	20	
2	20	
136	400	
20	9	
2720	3600	

Answer, $\frac{272}{360}$ or *l.* 00 *s.* 15 *d.* 1$\frac{1}{7}$.

Nor

Note, That by a ſhilling you muſt underſtand $\frac{1}{20}$ of a pound weight, and ſo by a penny $\frac{1}{240}$ of an ounce of the Aſſize of Bread, as by the Examples doth appear.

Note alſo in this Rule, if all your 3 numbers be of one Denomination, you ſhall work only with the Numerators, as in the ſecond Example, and in this which followeth:

How much Calico of $\frac{1}{2}$ Yard broad will ſerve to line 32 $\frac{1}{2}$ Yards of Satten which is $1\frac{1}{2}$ Yards broad?

$1\frac{1}{2}$ $\frac{65}{2}$ $\frac{3}{2}$

Here, the *Leſs* Breadth, the *More* Yards, wherefore Multiply the Numerator 65 by the Numerator 3, which makes 195, and divide by the Numerator 2, the Quotient will be 97 $\frac{1}{2}$, and ſo many Yards of Calico will line the 32 $\frac{1}{2}$ Yards of Satten.

CHAP. XIII.

Of Decimal Arithmetick.

1. A Decimal is a Fraction, whose Denominator is an Unite, and as many Cyphers following it as there are Figures and Cyphers in the Numerator.

2. The Numerator of a Decimal Fraction is distinguished from the whole number, to which it is join'd, by a point and a line drawn under it, and the Denominator is not expreſt, but underſtood according to the number of places of the Numerator.

Example.

As 7 $\underline{.27}$, 35 $\underline{.4}$, 12 $\underline{.08}$, 6 .752,

~~which signifies the common way~~

7 $\frac{27}{100}$, 35 $\frac{4}{10}$, 12 $\frac{08}{100}$, 6 $\frac{752}{1000}$.

So that if there be but one Figure of the Decimal parts, they be 10^{ths}, if 2 figures hundreds, if there be 3 figures in the decimal parts they be thouſands, *&c.* As in the following

following Table, where the uppermoſt numbers are Indices, or Exponents of Terms continually proportional, both ways from an unite, being affirmative in whole number, and negative in decimal parts, having this ſign leſs — ſet over them.

The TABLE.

9.	8.	7.	6.	5.	4.	3.	2.	1.	0.	1.	2.	3.	4.	5.	6.	7.	8.	9.
m.	m.	m.	m.	m.	m.	m.	c.	x.	1.	x.	c.	m.	m.	m.	m.	m.	m.	m.
		m.	m.	m.	c.	x.						x.	c.	m.	m.	m.	m.	
				m.	c.	x.								x.	c.	m.		
																x.	c.	m.

Note, that x ſignifies 10, c a hundred, and m a thouſand.

2. As in whole numbers every degree from the place of an unite is increaſed from the right hand towards the left in a tenfold proportion, ſo in decimal parts, every degree from the place of an unite is diminiſhed from the left hand towards the right in the ſame proportion. As for Example.

1	01	001	0001
10.	100.	1000.	10000.

10000. 1000. 100. 10. 1. || 1. 01. 001. 0001. 00001.
30000. 2000. 200. 20. 2. || 2. 02. 002. 0002. 00002.

4. Deci-

4. Decimal parts take their Denomina
from the place of their last Figure to the
hand, as 0 .5 is 5 tenths parts 0 .56 is
six hundred parts, 0 .056 is fifty six th
sand parts; *&c.*

5. Cyphers before whole numbers,
after Decimal parts, are of no value, but
whole numbers, and before Decimal
(that is next to the distinction) they
their value, for they make a degree by w
the value of Figures are estimated, or esteem
As 005 in whole numbers signifies on
and 0 .500 in Decimals signifies but 5 t
parts, and is no more in value than if it
set .5

6. Therefore in Decimal parts the dis
ction is always to be made, and the void
ces (if there be any) are to be supplied
Cyphers, as 0, 00005 is 5 hundred th
sand parts, which in common Arithme
is set down thus $\frac{5}{100000}$.

Here follows Addition, Subtraction, M
tiplication, and Division of Decimals, *&c.*

I. *Addition of Decimals.*

IN Addition the places of the ſame Denomination being ſet one under another, are to be added as in common *Arithmetick.*

Example.

	Feet	*Parts.*
36. 5	3794.	23
27. 25	584.	3
38. 75	947.	08
92. 3	4729.	7439
17. 2	148.	5
212. 00.	10094.	8599 parts.

II. *Subſtraction of Decimals.*

IN *Subſtraction* the places of the ſame Denomination being ſet under one another, are to be ſubſtracted as in common Arithmetick. As for Example.

Feet.

	Feet.	Parts.		Feet.	Par.
From	3794.	236	From	584.	3
Take	948.	080	Take	48.	5
Rest	2846.	156	Rest	535.	8

And from 3642 miles .7 parts, take 234 .37 parts, there remains 3408 .33 parts, *&c sic in aliis.*

III. *Of Multiplication of Decimals.*

1. IN Multiplication there must be so many places cut off (by the distinction towards the right hand) from the Product, as are the number of the Figures of the Parts of both the multiplying numbers. Examples follow.

As if 73 .4 be multiplied by 6 .2 I places them thus.

73 .4 (1)
6 .2 (1)
1468
4404
(2) 455 .08 Product.

And

And if	580 .34	(2)
Be multiplied by	47 .5	(1)
	290170	
	406238	
	232136	
Product	27566 .150	(3)

2. But if there be more Figures to be cut off then there are in the Product, then must Cyphers be plac'd before the Figures of the Product, to make up the number of Figures to be cut off, as for Example.

As if	.25	(2)
Be multiplied by	.13	(1)
	75	
	25	
	.0325	(4)

These Figures included between these two marks denotes the Decimal parts to be cut off, &c.

3. To value Decimal parts, in the parts of any measure given, multiply the Decimal parts by the number of the parts of the measure given contained in an unite, as if it were required to know how many Inches are contain'd in .79 parts of a Foot. You are in this Case to multiply by 12, because 12 Inches make a Foot.

(2) .79 parts.
12 Inches in a Foot.
158
79
(2) 9 .48 Product.

IV. *Of Division of Decimals.*

1. IN Division ſubſtract the number of the Figures of the parts of the Diviſor from the number of the Figures of the parts of the Dividend, and the remainder ſhall ſhew the number of the Figures of the parts of the Quotient.

As if 580 .34 be divided by 47 .5 the Quotient will be 12 .2

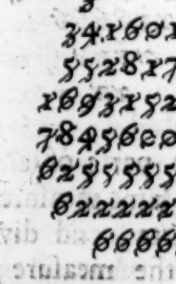
(2) 58034 (12 .2
(1) 475
475

2. But if the number of Figures of the parts of the Diviſor, be more than the number of Figures of the parts of the Dividend

then may you add as many Cyphers as shall be necessary to the parts of the Dividend, and then observe the former Rule.

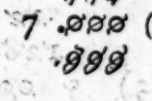
As if 7845 .6 be divided by 6 .25 the Quotient will be 1255 .296

As for *Example.*



The same is to be done if a lesser number is to be divided by a greater, as if 7 Inches were to be divided into 9 equal parts.

Example.



3. If the Figures to be cut off be more than there is in the Quotient, then must the defect be supplied by setting Cyphers before the Figures of the Quotient.

As

As if 3 .65487 be divided by 216, the Quotient will be .01692.

```
          11
          2941
          4362
         159845
(5)      365487 (01692
(0) sub  216666
(5)      2111
           22
```

4. To reduce the parts of any measure into Decimals of the same measure, add Cyphers to the given parts, and divide by the parts contained in the measure given, the Quotient is the Decimal parts required, as if it be requir'd to know what part of a Foot in Decimals 5 Inches is, add Cyphers to 5, and divide by 12.

Example.

```
          12
         128 (8
(3)      5 .000 (.416 parts.
0        1222
(3)      11
```

o compleat this Introduction to Decimal Arithmetick, here follows contracted Multiplication of Decimals, of great use in a long Multiplication.

F it be required to have the Product shortned by some of the last Figures, set he units place of the lesser number under the igure of the greater number, whose Index s equal, either to the number of Figures to e cut off from the whole number, or left in he Decimal parts, and then set the rest of he Figures of the lesser number, under the reater number from thence the contrary way; Then in multiplying, always begin om that Figure in the greater number hich is over the Figure of the lesser numer wherewith you multiply; yet having a spect to that increase which would arise rom the following Figure of the greater umbers.

In this Contraction are five Cases.

1. The first case where the Product is required with (0) places of parts to be cut off or separated.

The work at large for Example and Illustration of the Rule follows.

As

As if 246 .914 (3)
Were multiplied by 35 .27 (2)

1728398
493828
1234570
740742

The Product is 8708 .65678 (5)

The same operation contracted according the foregoing Directions, that nothing, (0) may remain.

246 .914
72 .53

7407
1235
94
17

The Product 8798. (0)

2. Case the second, where the Produ required (1) place of parts. In the op tion say, 3 times 1 is 3, but in regar times 4 makes 12, I add one more to th and make it 4, and so go on, *&c.*

246 .914
72 .53 (1)
74074
12346
494
172
Product 8708. (6)

3. Where the Product is required with two places cut of in the parts.

Here I say 3 times 4 is 12, and so go on as in common Multiplication.

246 .914 (2)
72 .53
740742
123457
4938
1728
8708 .65

4. Where

4. Where the Product is to have 3 p
cut off in the Decimal parts. See here
manner of operation.

246 .914.
72 .53
7407420
1234570
49383
17284
8708 .657 (3)

Here I say 3 times (0) is (0) whi
set down, then 3 times 4 is 12, and
proceed as in common Multiplication.
observe to set all the Figures even under
another, to the right hand, as in the se
Examples; contrary to the common wa

5. Where 4 places are to be cut o
the parts. Observe this Example.

246 .914..
72 .53
74074200
12345700
493828
172850
Product 8708 .6568 (4)

6. W

6. Where 5 places are to be cut off as in the first Example, but the operation contrary, as here you may observe in this contracted way.

246 .914 . . .	
72 .53	
740742000	
23457000	
4938280	
1728398	
Product 8708 .65678	(5)

And thus you have the five varieties or Cases plainly exemplified, which I presume will be easily understood by the meanest Capacity.

That this contracted Multiplication may be yet made more plain and easy, take another Example from Sir *Samuel Moreland's* Method, which he directs thus, *viz.*

In the first place, wherever 2 Multiplications consists of above 3 places, he doth recommend to all Practioners (as a thing which he has sufficiently experienc'd) to make use of a *Tariffa*, or Table of Multiplication for the *Multiplicand*: and though it may and will seem at the first view to be more tedious, yet it will be found to be the shortest

shorteſt of all other ways whatſoever, being performed by Addition only, and leſs ſubject to errour; and not only ſo, but whereas all other operations of Multiplication do extreamly diſtort the Eyes by looking ſtedfaſtly upon Figures placed Diagonally; but by this *Tariffa* the Eye looks on them always in a ſtreight line, and no otherwiſe.

For Example. Suppoſe the two ſumms to be multiplied one by another were 259879 .890625, and 1 .1173698 but the Product to conſiſt of no more than eleven places.

Tariffa for the Multiplicand.

1	259879890625
2	519759781250
3	779639671875
4	1039519562500
5	1299399453125
6	1559279343750
7	1819159234375
8	2079039125000
9	2338919015625

Having made a *Tariffa*, and placed the *Multiplicand*, and *Multiplicator*, as before directed, becauſe in the Multiplicand there are two

twelve places, and eight in the Multiplicator; it is desired to contract them to eleven places. First let a line be drawn, leaving 8 places to the right hand, and then let all the imaginary places underneath be supplied with points or cyphers decreasing in a triangular Figure to nothing.

Then let the Multiplication be perform'd as follows. Let the last Figure in the Multiplicator be found in the margin of the *Tariffa*, and the Product answerable to it subscrib'd; only let eight places be imaginary according to the number of points or cyphers, and let the remaining Figures (*viz.* 20790) be transcribed on the other side of the line. Under the next Figure of the Multiplicator (9) are 7 points or cyphers, therefore the Product answering to (9) in the margin of the *Tariffa* being found, *viz.* 233891 | 9015625. Let the first seven Figures to the right hand be left, and the other 6 inscrib'd, as in the Example is very apparent; and thus must the operation be perform'd till all be finished; and considering that there are eight several Products, it may be well imagin'd, that at least two must be carried from the last place, and therefore (2) being added to (27) there must be set down (9) and (2) carried to the next place, and thus must be wrought the whole Multiplication; and at

laſt it gives the Product. As for Example. See the operation, *viz.*

259879 .890625
1 .1173698

20790	. . . . .
233891	. . . . .
1559279	. . . . .
7796396	. . . . .
181915923	. . . .
2598798906	. . .
25987989062	. .
290381 .94139	.
	Product.

And after this manner may any Multiplication be contracted to any number of places more or leſs, and it is of great uſe in many Calculations where great numbers are uſed, as in making Tables of Intereſt and Rebate, *&c.*

A Ta

A Table of Reduction of Shillings, Pence, and Farthings into Decimal Fractions.

Shillings.	Decimals.
19	.95
18	.9
17	.85
16	.8
15	.75
14	.7
13	.65
12	.6
11	.55
10	.5
9	.45
8	.4
7	.35
6	.3
5	.25
4	.2
3	.15
2	.1
1	.05

Pence.	Decimals.
11	.0458333
10	.0416666
9	.0375
8	.0333333
7	.0291666
6	.025
5	.0208333
4	.0166666
3	.0125
2	.0083333
1	.0041666

Farthings.	Decimals.
3	.003125
2	.0020833
1	.0010416
½	.0005208
¼	.0002604
⅛	.0001302

A Table for Reduction of Pence and Farthings into Decimal Fractions, to the hundreth part of a Farthing.

Farthings.	Decimal Fractions.
1 Farth.	.0010416
2 Farth.	.0020833
3 Farth.	.0031250

Pence and Farthings.	Decimal Fractions.
1 Penny	.0041666
1 Farth.	.0052083
2 Farth.	.0062500
3 Farth.	.0072916
2 Pence	.0083333
1 Farth.	.0093750
2 Farth.	.0104166
3 Farth.	.0114583
3 Pence	.0125000
1 Farth.	.0135416
2 Farth.	.0145833
3 Farth.	.0156250
4 Pence	.0166666
1 Farth.	.0177708
2 Farth.	.0187500
3 Farth.	.0197916

Pence and Farthings.	Decimal Fractions.
5 Pence	.0208333
1 Farth.	.0218750
2 Farth.	.0229166
3 Farth.	.0239583
6 Pence	.0250000
1 Farth.	.0260416
2 Farth.	.0270833
3 Farth.	.0281250
7 Pence	.0291666
1 Farth.	.0302083
2 Farth.	.0312500
3 Farth.	.0322916
8 Pence	.0333333
1 Farth.	.0343750
2 Farth.	.0354166
3 Farth.	.0364583
9 Pence	.0375000
1 Farth.	.0385416
2 Farth.	.0395833
3 Farth.	.0406250

Pence and Farthings.	Decimal Fractions.	Pence and Farthings.	Decimal Fractions.
10 Pence	.0416666	11 Pence	.0458333
1 Farth.	.0427082	1 Farth.	.0468750
2 Farth.	.0437500	2 Farth.	.0479166
3 Farth.	0447916	3 Farth.	.0489583

CHAP. XIV.

Examples of the use of Decimal Arithmetick in measuring Superficies, &c.

1. THere is a piece of Wainscot 15 Yards 3 Quarters one way, and 25 Yards and a Quarter the other, what is the Superficies, or Area thereof?

For 3 Quarters, I set down the Decimal thus .75, and for a Quarter of a Yard I set it down thus .25

So then the work in Order stands thus.

	25 .25	(2)
	15 .75	(2)
	12625	
	17675	
	12625	
	2525	
The Content	397 .6875	(4.)

Which is 397 square Yards, and above an half and better, or nearer three Quarters of another square Yard.

2. So if the side of a square Superficies be six

ſix Foot, the *Area* or content thereof will be found to be 36 ſquare Feet, for 6 times 6 is 36.

3. If the ſide of a ſquare pavement of Stone be 15 .7 Feet, the ſuperficial content of that pavement will be 246 .49 Feet, that is 246 ſquare Feet, and near an half, for 246 .49 is the ſquare or Product of 15 .7 multiplied, or drawn into it ſelf, and ſo a ſquare piece of Wainſcot of 8 .25 Yards, will be found to contain 68 ſquare Yards, and .06 parts, or 6 of 100 parts of another.

4. A piece of Tileing in form of a long ſquare, whoſe length is 18 .5 Feet, and breadth 11 .7 will be found to contain 216 .45 ſquare Feet, which being reduced, will be 2 .1645 ſquares of Tileing, by allowing 100 ſquare Feet to one ſquare of Tileing, according to the uſual cuſtom.

5. A parcel of Land lying in the form of a long ſquare, be 48 .75 Perches or Poles in length, and 36 .25 in breadth, the Area or content in ſquare Perches will be found 1767 .18 which reduced will be 11 Acres 7 Perches for the Area or content of the ſame.

6. If the Diameter of a Circle be 28 .25 what is the Circumference? the Anſwer will be 88 .749 †

For the proportion is as 113 to 355, or as 1 is to 3 .14159, so is the Diameter to the Circumference; Therefore if you multiply the Diameter 28 .25 by the said 3 .14159 (according to the Rule in Decimals) the Product shall be the Circumference required, *viz.* 88 .749, *&c.*

7. If the Diameter be 28 .25, and you desire the Area, or superficial content of the said Circle, the answer will be 626 .79†. For as 1 is in proportion to .78539, so is the square of the Diameter to the content, *viz.* the superficial content, and therefore you are always first to square the Diameter given (which is done by multiplying the said Diameter into it self) then multiply the square thereof by the aforesaid Decimal Fraction, *viz.* .78539 (which is always a standing number) and the Product (cutting off the parts according to the Rule) shall be the superficial content required.

8. If the Diameter of the said Circle be the same, *viz.* 28 .25 the side of a square which may be inscribed therein, will be found to be 19 .975†

For the square Root of half the square of the Diameter, or the square Root of the double of the square of the Semi-diameter, shall be the side of the square desired. [*How to extract the Square and Cube Root shall be shewed*

hewed in the next Chapter. Or without the ſquare Root, you may work by this proportion. As 1. is to .707106, ſo is the Diameter to the ſide requir'd; Therefore (always in this caſe) multiply .707106, by the Diameter given, and the Product will be the ſide of the inſcribed ſquare ſought.

9. Again, if you have the Circumference of a Circle given, and deſire to know the Diameter, you may ſay as 355 is to 113, or as 1, is to .38309, ſo is the Circumference to the Diameter; and therefore if you multiply the given Circumference by .38309 the Product ſhall be the Diameter; ſo if the Circumference be 88 .75, the Diameter will be found 28 .249, *viz.* 28, 249 *ferè.* And after this manner infinite Examples (almoſt) might be enumerated to illuſtrate Decimal Arithmetick, but let theſe be accepted at preſent, and for ſuch as delight in this Exerciſe, I offer theſe following Examples for Practice.

1. If the Diameter of a Circle be 42 Inches, the Circumference will be 131 .9472

2. If the Diameter be 42, the Area, or ſuperficial content will be 1385 .342072

3. If the Diameter of a Circle be ſtill 42, the ſide of the ſquare inſcribed will be

found 29 .698494, so the Diameter being the same, the side of the square equal will be 37 .2204

4. If the Circumference be as before 131 .95 the Diameter will be found to be 42, and by the same Circumference the Area will be found 1385 .52 †, *&c.* Or by the *Logarithms*, which are also Decimal Numbers, (and now are very well known, and in every mans hand, especially those that are *Mathematically* inclin'd) all the aforesaid Operations may be very compendiously contracted as in these following *Analysis*.

BIBLIOTHECA BODLEIANA

1. To

1. To the Logar. of the { Diameter / Circumfer. } Add the Log. { .0497151 / .9849485 / .9947545 } { .9502849 / .9352333 / .9450394 } And the ſumm will be the Logar. of { Circumference. / Side of the ſquare Inſcrib'd. / Side of the □ Equal. / Diameter. / Side of the □ Inſcrib'd. / Side of the □ Equal. }

2. To the Double Logar. of the { Diameter. / Circumference. } Add { .9895090 / .8900788 } And the ſumm will be the Logar. of the Area, or Content.

3. To the Logar. of the Area add the Logarithms. { .0104910 / .1099212 / .9803880 / .0000000 } And the ſumm will be the Double Logar. of the { Diameter. / Circumference. / Side of the □ Inſcrib'd. / Side of the □ Equal. }

4. To the Logar. of the ſide of the ſquare Add the Logar. { .0150515 / .0052455 / .0647666 / .0549606 } And the ſumm will be the Logar. of the { Diameter of the { Circumſcrib'd Circle. / Circle Equal. } / Circumfer. of the { Circumſcrib'd Circle. / Circle Equal. } }

CHAP. XV.

How to Extract the ſquare Root of a number given, &c.

1. POint your given number, *viz.* place a prick over the firſt Figure towards your right hand, and omitting every other Figure, place another prick or point over the third, the fifth, the ſeventh, and ſo on, proceeding according to your number of Figures: Every Figure thus ſeparated are called points; and ſo many points as are in the number propounded for Extraction, ſo many Figures ſhall be in the Root requir'd, if your number be rational.

2. Seek the greateſt ſquare in the firſt point towards the left hand (which you may ſee by the beginning of the Table of Squares and Cubes) ſubſtract that ſquare from the firſt point, and place its Root in the Quotient, and place the remainder after ſubſtraction underneath the firſt point.

3. To the remainder bring down the next point, placing it towards the right hand, and call this the Reſolvend.

4. Double the Quotient, and place the Product

Product on the left hand of the Reſolvend, diſtinguiſhed thus by this mark .). *viz.* a crooked line, or part of a Parentheſis, which call the Diviſor.

5. Seek how often this double Quotient is contained in all the Figures of the Reſolvend, except the laſt towards the right hand; after the manner of Diviſion write the Anſwer in the Quotient, as alſo on the right hand of the doubled Quotient, or Diviſor.

6. Multiply the Diviſor with the Figure laſt added, by the Figure laſt placed in the Quotient, and ſubſtract the Product from the Reſolvend, ſubſcribing the remainder.

7. To this Remainder, bring down the next point for a new Reſolvend, and proceed herewith as with the firſt remainder in the third Rule (or Precept) reiterating the work of the fourth, fifth and ſixth Rules aforegoing, continuing ſo to do until the Extraction be finiſhed. And thus the ſquare Root of 3364, will be found 58. of 6889. 83. of 17689, 133, *&c.* As may be ſeen in the Table.

Examples

Examples for Practice.

What is the ſquare Root of

(1) . .
5776 (76
49
146) 876
876
000

(2) . .
7744 (88
64
168) 1344
1344
0000

So the Root of 7744 is (88.) and of 5776. (76)

Other Examples.

What is the ſquare Root of 70756? Anſwer 266. Thus wrought by the aforeſaid Rules, or Precepts, *viz.*

(3) . . .
70756 (266
4
46) 307
276
526) 3156
3156
0000

What

What is the ſquare Root of 169744? Anſwer 412.

```
          . . .
(4)      169744 (412
         16
         ----
81)       97
          81
         ----
822)      1644
          1644
         ----
          0000
```

And after this manner proceed with all rational numbers.

How to Extract the Square Root of a Surd number.

WHen a *ſurd number* is propos'd for Extraction, proceed therewith in all reſpects, as if it were a rational number (I mean commenſurable by its Root) and when you have finiſhed all the points, you will find a remainder, which ſhews you have found the greateſt whole number that the Root can conſiſt off; and to find the *Decimal Fraction* to be added to this whole number, to bring the Root near the truth, do thus, Place two Cyphers on the right hand of the remainder,

remainder, and continue the extraction as before (by the fourth, fifth, and sixth Rules) this will produce one Figure to be added in the Quotient, which you are to distinguish from the former by a comma (,) thus. And so by adding 2 Cyphers to the last remainder, you may continue your extraction, two or three places of *Decimals*, or farther if you please.

EXAMPLE.

What is the nearest Square Root of this number?

```
          . . .
          56783 (238, 29
          4
          ----
   43)    167
          129
          ----
  468)     3883
           3744
           -----
  476 .2)  13900
            9524
           ------
  476 .49)  437600
            428841
            ------
              8759
```

And

And thus the neareſt Root is 238 .29, and ſo the neareſt ſquare Root of 1372, will be found 37 .04, and alſo the neareſt Root of 155424 will be 394 .243, *&c. & ſic in alijs.*

Directions how to extract the Cube Root in whole numbers that are commenſurable.

1. POint the given numbers, *viz.* Put a prick over the firſt Figure to the right hand, and omitting two Figures between every point, ſet another prick over the fourth Figure, and another over the ſeventh, and ſo proceed as occaſion requires; where note (both in the *ſquare* and *Cube*) that ſo many as you have pricked, or pointed, of ſo many Figures conſiſts your Root.

2. Take the greateſt *Cube number* out of the firſt point, towards the left hand, (which you may find by the Square, and Cubes of the 9 Digits, at the beginning of the following Table thereof) and ſet the Root thereof in the Quotient, and the *Cube* thereof under the firſt point; ſubſtract it alſo therefrom, and ſubſcribe the remainder; To the remainder bring down the next point, as in the extraction of the ſquare Root, and call this the *Reſolvend.*

3. Square

3. Square the Quotient, and multiply the Square by 3; This you are to subscribe under the *Resolvend*, and call it the *Triple Square*, then multiply the Quotient by 30, and place it under the *Triple Square*, which call the *Triple Quotient*, and add the *Triple Square* and *Triple Quotient* into one summ, and call it the *Divisor*, and draw a line underneath.

4. Seek how often this Divisor is contained in the Resolvend, as in ordinary Division, and place the Answer in the Quotient.

5. Multiply the Triple Square by the Figure last placed in the Quotient, and subscribe the Product orderly underneath the Divisor.

6. Square the Figure last placed in the Quotient, and thereby multiply the Triple Quotient; and place it underneath the last Product.

7. Cube the last Figure placed in the Quotient, and subscribe that underneath the former Products.

8. Add these three numbers together into one summ, and subtract it from the Resolvend, subscribing the remainder.

9. To the remainder bring down the next point (if so many) for a new *Resolvend*, with which proceed in all respects as before; when

when you have found the last Figure in the Quotient, reiterating of the work of the third, fourth, fifth, sixth, seventh, and eighth Rules before expreſt; But note, that if the total Found, according to the last Rule exceed the *Reſolvend*, out of which you are to ſubſtract it; this argues the work is erronious, and to correct it, you muſt diminiſh the Figure laſt placed in the Quotient, by an Unite, as in ordinary Diviſion, repeating again the work of the ſixth, ſeventh, eighth and ninth Rules.

Example.

What is the *Cube Root* of this following number, *viz.*

12167 (23
8
4167 Reſolvend.
1200
60
1260 Diviſor.
3600
540
27
4167
....

And

And thus you may find the Cube Root of the number 185193 will be 57, and the Cube Root of 13144256, will be found 236, as may be proved by Cubeing the said number, that is, first multiplying it by it self, and then the Product by the first number. If there be a remainder, add 3 Cyphers, and continue the extraction according to the Rules.

Example.

What is the Cube Root of this *surd number?*

88310 (44.53
64
24310 Resolvend.
4800
120
4920 Divisor.
19200
1920
64
21184
3126000 Resolverid.
580800
1320

582120

582120	
2904000	
33000	
125	
2937125	Subducend.
188875000	Reſolvend.
59407500	
13350	
59420850	Diviſor.
178222500	
120150	
27	
178342677	Subducend.
105322323	Remainder.

By theſe Examples and the aforeſaid Directions, the buſineſs of the extraction of the Square and Cube Root is made as plain and eaſy as 'tis poſſible to be expreſſed; and in this laſt Example there are Triple Cyphers added to bring out the Decimal number .53 So that the neareſt Cube Root of 88310. is 44.53

Here follows a Table of Squares and Cubes exactly Calculated to 240.

A Table

A Table of Squares and Cubes.

Roots.	Squares.	Cubes.	Roots.	Squares.	Cubes.
1	1	1	25	625	1562
2	4	8	26	676	1757
3	9	27	27	729	1968
4	16	64	28	784	2195
5	25	125	29	841	2438
6	36	216	30	900	2700
7	49	343	31	961	2979
8	64	512	32	1024	3276
9	81	729	33	1089	3593
10	100	1000	34	1156	3930
11	121	1331	35	1225	4287
12	144	1728	36	1296	4665
13	169	2197	37	1369	5065
14	196	2744	38	1444	5487
15	225	3375	39	1521	5931
16	256	4096	40	1600	6400
17	289	4913	41	1681	6892
18	324	5832	42	1764	7408
19	361	6859	43	1849	7950
20	400	8000	44	1936	8518
21	441	9261	45	2025	9112
22	484	10648	46	2116	9733
23	529	12167	47	2209	10382
24	576	13824	48	2304	1105

A Table of Squares and Cubes.

Roots.	Squares.	Cubes.	Roots.	Squares.	Cubes.
49	2401	117649	73	5329	389017
50	2500	125000	74	5476	405224
51	2601	132651	75	5625	421875
52	2704	140608	76	5776	438976
53	2809	148877	77	5929	456533
54	2916	157464	78	6084	474552
55	3025	166375	79	6241	493039
56	3136	175616	80	6400	512000
57	3249	185193	81	6561	531441
58	3364	195112	82	6724	551368
59	3481	205379	83	6889	571787
60	3600	216000	84	7056	592704
61	3721	226981	85	7225	614125
62	3844	238328	86	7396	636056
63	3969	250047	87	7569	658503
64	4096	262144	88	7744	681472
65	4225	274625	89	7921	704969
66	4356	287496	90	8100	729000
67	4489	300763	91	8281	753571
68	4624	314432	92	8464	778688
69	4761	328509	93	8649	804357
70	4900	343000	94	8836	830584
71	5041	357911	95	9025	857375
72	5184	373248	96	9216	884736

A Table of Squares and Cubes.

Roots.	Squares.	Cubes.	Roots.	Squares.	Cubes.
97	9409	912673	121	14641	1771561
98	9604	941192	122	14884	1815848
99	9801	970299	123	15129	1860867
100	10000	1000000	124	15376	1906624
101	10201	1030301	125	15625	1953125
102	10404	1061208	126	15876	2000376
103	10609	1092727	127	16129	2048383
104	10816	1124864	128	16384	2097152
105	11025	1157625	129	16641	2146689
106	11236	1191016	130	16900	2197000
107	11449	1225043	131	17161	2248091
108	11664	1259712	132	17424	2299968
109	11881	1295029	133	17689	2352637
110	12100	1331000	134	17956	2406104
111	12321	1367631	135	18225	2460375
112	12544	1404928	136	18496	2515456
113	12769	1442897	137	18769	2571353
114	12996	1481544	138	19044	2628072
115	13225	1520875	139	19321	2685619
116	13456	1560896	140	19600	2744000
117	13685	1601613	141	19881	2803221
118	13924	1643032	142	20164	2863288
119	14161	1685159	143	20449	2924207
120	14400	1728000	144	20736	2985984

A Table of Squares and Cubes.

Roots.	Squares.	Cubes.	Roots.	Squares.	Cubes.
145	21025	3048625	169	28561	4826809
146	21316	3112136	170	28900	4913000
147	21609	3176523	171	29241	5000211
148	21904	3241792	172	29584	5088448
149	22201	3307949	173	29929	5177717
150	22500	3375000	174	30276	5268024
151	22801	3442951	175	30625	5369375
152	23104	3511808	176	30976	5451776
153	23409	3581577	177	31329	5545233
154	23716	3652264	178	31684	5639752
155	24025	3723875	179	32041	5735339
156	24336	3796416	180	32400	5832000
157	24649	3869893	181	32761	5929741
158	24964	3944312	182	33124	6028568
159	25281	4019679	183	33489	6128487
160	25600	4096000	184	33856	6229504
161	25921	4173241	185	34225	6331625
162	26244	4251528	186	34596	6434856
163	26569	4330747	187	34969	6539203
164	26896	4410944	188	35344	6644672
165	27225	4492125	189	35721	6751269
166	27556	4574296	190	36100	6859000
167	27889	4657463	191	36481	6967871
168	28224	4741632	192	36864	7077888

A Table of Squares and Cubes.

Roots.	Squares.	Cubes.	Roots.	Squares.	Cubes.
193	37249	7189057	217	47089	10218313
194	37636	7301384	218	47524	10360232
195	38025	7417875	219	47961	10503459
196	38416	7529536	220	48400	10648000
197	38809	7645373	221	48841	10793861
198	39204	7762392	222	49284	10941048
199	39601	7880599	223	49729	11089567
200	40000	8000000	224	50176	11239424
201	40401	8120601	225	50625	11390625
202	40804	8242408	226	51076	11543176
203	41209	8365427	227	51529	11697083
204	41616	8489664	228	51984	11852352
205	42025	8615125	229	52441	12008989
206	42436	8741816	230	52900	12167000
207	42849	8869743	231	53361	12326391
208	43264	8998912	232	53824	12487168
209	43681	9129329	233	54289	12649337
210	44100	9261000	234	54756	12812904
211	44521	9393931	235	55225	12977875
212	44944	9528128	236	55696	13144256
213	45369	9663597	237	56169	13312053
214	45796	9800344	238	56644	13481272
215	46225	9938375	239	57121	13651919
216	46656	10077696	240	57600	13824000

Some uses of the Square Root.

1. IF 14900 men be put into a Square Battle, how many will there be in Rank, and how many in File?

Extract the Root of 14900, the neareſt Root is 122, as may be ſeen by the Table, or will be found by operation, and 16 remains, ſo that there will be 122 in Rank, and as many in File, and 16 men over.

2. In a right angled plain Triangle, 'tis demonſtrated by the 47th of the firſt Book of *Euclid's Elements*, that the Square of the *Hypotenuſa* is equal to the ſumm of the Squares of the Baſe and Perpendicular; therefore having the ſumm of the Squares of the Baſe and Perpendicular of any right angled Triangle; extract the Square Root thereof, and that ſhall be the length of the *Hypotenuſa*. This Propoſition is of uſe in Trigonometry and Navigation, as alſo many other things of as good uſe.

So having the content of a ſquare piece of ground, if you extract the ſquare Root of that number, it leaves the ſide of that ſquare in the ſame meaſure; Or in Timber not truly ſquare, if you multiply the breadth of the piece by the depth taken in Inches, and extract the ſquare Root of the Product,

it gives the true ſquare thereof, *&c. cum multis aliis.*

3. If you deſire to make a ſquare 2. 3. 4. or any number of times bigger than a ſquare given; then firſt ſquare the ſide thereof, and ſo find the content of the given ſquare.

In the next place double, triple, or Quadruple, the ſaid Content or Area, and the ſquare Root of that number ſhews the ſide of the ſquare deſired, either double or triple to the given ſquare. As for Example.

The ſide of a ſquare being 10, the content thereof is 100, which doubled is 200, whoſe Root 14. 14 is the ſide of the ſquare; ſo if the content were 300, the ſide will be found 17. 32. If 400, the ſide or Root is 20.

4. After the ſame manner that you increaſe a ſquare Superficies, ſo you may deal with a Circle, knowing either the Diameter, Semidiameter, or Circumference thereof: Thus, firſt ſquare it (which is only multiplying it into it ſelf) then Double, or Triple, or Quadruple the number, and extract the ſquare Root thereof; ſo you ſhall have thereby the Diameter or Circumference of a Circle that ſhall be 2. 3. or 4 times bigger than the Circle propoſed. As for *Example.*

Let the Diameter of a Circle be 7 Inches, whoſe ſquare is 49, the double thereof is

98.

98, the Root thereof is 9. 90 parts *ferè*. The Treble thereof, or 49 by 3, is 147, and the Root of that is 12. 11, the Quadruple thereof is 49 by 4. 196 the Root thereof 14. which is double to the first Diameter, and 4 times in value. And thus if the Compass of a Cable be 7 Inches about, another of 14 Inches Compass, shall Fathom for Fathom weigh 4 times the weight: And so likewise if it be but 3 Inches and a half in Compass (which is the half of 7 Inches) it shall be but a quarter of the weight and strength, and thus you may find the weight and strength of any Cable, *&c.* with many other varieties, largely treated of, in most *Mathematical Books*, whereof in this small Volumn it cannot be expected, this being sufficient to initiate or prepare the Reader for the perusal of those Authors that very amply treat of such matters.

Note, that by this method of squareing and extracting of Roots, the whole Canon of natural *Sines*, *Tangents*, and *Secants*, are made as is copiously handled by many good Authors.

Note also, That in the extraction of Roots Arithmetically, the work is not much unlike Division, differing only in this, that whereas in Division the Divisor is known, but in this work 'tis always sought. And as in Division

you have only one Divisor, but here you change your Divisor at each removing, which is at the finding of every Figure in the Root.

Note farther, that though it has been already shewn how to reduce the remainder in a *surd* number (whose Root should be extracted) to a Decimal Fraction, I shall also insert another way, which may to some persons be as acceptable, which is this; Suppose I would have the Root of 18, the nearest is 4, and 2 remains. Now not knowing what Fraction to make of this remainder, having no certain Divisor to stand for the Denominator to the Numerator or remainder.

Then observe this Rule approved of by some able *Mathematicians*, *viz.*

Double the remainder of the Numerator, and Quadruple the Root, and thereunto add 1 for the Denominator to the said Numerator, as in the following Example.

Suppose of 18, the nearest Root is 4, and 2 remains; this 2 being doubled makes 4 for a Numerator, and 4 the Root being Quadrupled or multiplied by 4, is 16; to which add 1 it makes 17, for the Denominator: Hence, I conclude, that $4\ \frac{4}{17}$ is the nearest square Root of 18. which can be discovered. For if you reduce $4.\ \frac{4}{17}$ into one common

Denomination,

Denomination, and then square that number the Product will be 17 $\frac{15}{16}$, which is but $\frac{1}{16}$ too little.

Some uses of Cubick numbers and their Roots.

1. *Cubick numbers* and their Roots are in use, not much different from those of *Squares*, only what is performed in superficies by the former squares, These *Cubick numbers* are used after the same manner in solid Bodies, as Timber, Stone, or any other bodily or solid substance. As for *Example*.

If you would double the *Cube*, or make one solid Body to contain as much as two lesser solids. Then take the side of each *Cube*, and multiply each of them *Cubically*, then add them both together, and extract the *Cubick* Root of the said summ, and that shall be the side of a *Cube* equal in solidity to both the former; as thus, suppose a Cube of 4 Inches on each side, and you desire a *Cube* to contain double the same.

The Cube of 16 is 64, the double whereof is 128, the Cube Root thereof is 5, and somewhat more, *viz.* 5. 015. But if you double the side of the aforesaid *Cube*, and make it 8 Inches every way, such a

Cube will be 8 times bigger than that of 4 Inches, for 8 times 8 is 64, and 8 times 64 is 512, which is the solid content of the Cube of 8, and the aforesaid solid which contains 64, may be found 8 times in this.

2. As in square solids, so 'tis in round, or such Bodies as are in a Globular form, as *Bullets*, *Globes*, &c. So that knowing the weight of any Bullet, whose Diameter is known, the weight of another may be had thereby; and thus a Bullet of Iron of 4 Inches Diameter, being found by experience to weigh 9 pounds, and a Bullet of 5 Inches and a little more Diameter shall weigh 18 pounds, which is double the weight, and a Bullet of 8 Inches Diameter will weigh 72 pounds, which is 8 times the weight of that of 9 pounds and 4 Inches Diameter.

And according to this method, by Cubing the Diameter of any Bullet, you may find the weight thereof by this Proportion. *As the Cube of* 4 *which is* 64 *to* 9 *pound, so is the Cube of* 5, *which is* 125, *to* 17 *pound* 58 *parts; and so by the weight given, the Diameter may be found*; and thus as it is in round and square solid Bodies, so it is in all other solid Bodies, so that knowing the mold and burthen of one Ship, you may build another thereby on the same mold, of what burthen

burthen you please, either more or less; thus measure the length of the Keel, also the length of the Midship Beam, the depth in the Hold, and such like parts which make the form, shape, or mold of the Ship, and multiply them Cubically, part by part, or member by member, and thereby compose every part proportionable. *Example.* If a *Ship* of a 100 *Tun* be 44 Foot long at the Keell, of what length shall the Keell be of 200 *Tuns?* Since all solids are in Triple proportion to their correspondent sides or lines.

Therefore I seek the Cube of 44, which is 85184, and say by the Rule of proportion, as 100 *Tuns* is in proportion to 85184, so is 200 Tuns to 170368, whose *Cubick* Root is near $55\frac{11}{25}$, or 437 parts. Or if I double the *Cube* of 85184, which is 170368, and extract the Cube Root thereof, the result is the same.

This I think sufficient to illustrate the use of the *Square* and *Cube*, and the *extraction* of their *Roots*. Infinite Examples more may be found in many Authors, as such as Treat of *Algebra*, *Geometry*, *Gunnery*, &c. to which I refer the inquisitive Reader.

CHAP. XVI.

The RULE *of* FELLOWSHIP, *without Time.*

OF this Rule of Fellowſhip, there are two kinds, the one with Time, the other without Time. It is a right neceſſary Rule for Merchants, Partners in Ships, Adventurers at Sea, and all ſuch as Trade in Company with a joint Stock, and are to ſhare a proportional part, either of Gain or Loſs.

We will begin with Fellowſhip without Time, to work which this is

The RULE.

Add the ſeveral Summs, that the ſeveral perſons Adventuring put into Stock all together, which ſumm ſhall be the firſt number in the Rule of Three Direct. Then, *the ſumm that is either* gained *or* loſt *in the Adventure, ſhall be the ſecond number in the Rule of Three:* And *The third number in the Rule ſhall be the ſumm of money that every perſon put into Stock ſeverally.*

Queſtion

Question 1.

Simon, *George* and *Peter*, make a Stock of money to the value of 3762 *l.* which they imploy in Trade, till at length they make it worth 5430 *l.* *Simon* puts in 563 *l.* *George* puts in 765 *l.* and *Peter* puts in 2434 *l.* how much must either of the parties have of the Gain, in full recompence of his money put in.

Add the several summs that the three parties put in together thus,

	l.
Simon puts in	563
George puts in	765
Peter puts in	2434
The whole Stock	3762

First, for Simons *share, say,*

If 3762 *l.* the whole Stock, Gain 5430, what shall 563 *l.* Gain? which is *Simons* share put in.

Place your numbers as in the Example, and working by the Rule of Three, you shall find 812 *l.* $\frac{2146}{3762}$ parts of a pound, which is *Simons* share.

See the work.

First,

First, For *Simons* share.

	l.		l.		l.
If	3762	gain	5430	what	563?

```
      563
    16290
   32580
  27150
  3057090

  (2
   3
   9 (3
  104 (4
  4785
  69947 (6
  3057090 (812 1348/3762
  376222
   3766
    37
```

Secondly,

Secondly, For George's share.

	l.		*l.*	*l.*
If	3762,	Gain	5430,	what 765?

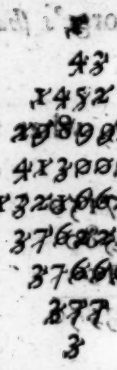
```
  765
 ----
 27150
 32580
38010
-------
4153950

  13 (7
 3259 (0
 149171 (2
4153950 (1104 702/1762
3762222
 37666
  377
   3
```

Thirdly, For Peter's share.

	l.		*l.*	*l.*
If	3762,	Gain	5430,	what 2434?

```
     5430
    -----
    73020
   9736
  12170
 --------
 13216620
```



For Peter's share 3513 $\frac{714}{3763}$

So that,

Simon gained	812	$\frac{2346}{3763}$
George gained	1104	$\frac{701}{3763}$
Peter gained	3513	$\frac{714}{3763}$
In all	5429	$\frac{3763}{3763}$

equal to the whole gain.
The Fractions being reduced into Coin.

	l.	*s.*	*d.*	*q.*
Simon's share will be	812	12	5	$\frac{2346}{3763}$
George's share will be	1104	3	8	3 $\frac{701}{3763}$
Peter's share will be	3513	3	9	2 $\frac{714}{3763}$
The whole gain	5430	0	0	0

Which proves the work to be true.

Question

Question 2.

A. B. and *C.* join their money to make a Stock of 25000 *l.* of which *A.* laid in 10000 *l.* *B.* 8000 *l.* and *C.* put in 7000 *l.* with this (after a certain time in Trading) they gained 7500 *l.* how must this be parted?

First for A.

Say, if 25000 gain 7500, what 10000? Or shorter, if 25 get $7\frac{1}{2}$, what 10? Multiply $7\frac{1}{2}$ by 10, it produceth 75, which divided by 25, the quotient is 3, that is, (restoring the 3 Cyphers) 3000 *l.* for *A.*

Then for B.

Say, if 25000 gain 7500, what 8000? Or shorter, if 250 get 75, what 80? Multiply and divide as the *Golden Rule* requires, and to the quotient, restore the two Cyphers, then it will be 2400 *l.* for *B.*

Lastly, For C.

Say, if 250 give 75, what 70? answer 21, to which put the two Cyphers, it makes 2100 for *C.*

And

And these three, 3000, 2400, and 2100 being added together, make 7500. And have that proportion as the particular Stocks had: and therefore the work is right.

(I) *For* A.

If 25 gain $7\frac{1}{2}$, what 10?

$$7\tfrac{1}{2}\ \frac{15}{2}\ \overset{150}{\underset{2}{\times}}\ \frac{10}{1}$$

$$\begin{array}{r} \cancel{1} \\ \cancel{150}\ (75 \\ \cancel{22} \end{array}$$

$$\begin{array}{r} \cancel{1} \\ \cancel{75}\ (3 \\ \cancel{25} \end{array}$$

3000 *l.* for *A.*

(II) *For* B.

If 25000 gain 75, what 80?

$$\begin{array}{r} 80 \\ \hline 250)\ 6000\ (24 \\ \cdot\ \cdot \\ \hline 500 \\ 1000 \\ \hline 1000 \\ 2400 \end{array}$$

(III)

(III) For *C.*

If 250 gain 75, what 70?

70

250) 5250 (21

..

500

250

250

2100 for *C.*

And if instead of gaining 7500 *l.* whereby every one is supposed to have his Stock and a part of the gains; they had lost 7500 *l.* then of their particular Stocks had been due to them, but so much as would be left after their proportional parts of the loss were abated.

Question 3.

A.B. and *C.* with a joint Stock of 25000 *l.* gain 7500 *l.* of which *A.* gets 3000. *B.* 2400 *l.* *C.* 2100 *l.* what was their Stock? This is but the Converse of the former; therefore say, if 5700 require 25000, what shall 3000 require? *Answer*, 10000 for *A.* and so work for the other two.

CHAP.

CHAP. XVII.

The RULE *of* FELLOWSHIP, *with* TIME.

IN this Rule of Fellowship with Time, there are two things chiefly to be considered, Namely, the difference of ſtock, and the difference of time. The beſt way to perform it is by multiplying the money and the time of each Adventurer together, and all thoſe products added together to be the whole Stock. For,

As the Summ of theſe Products is to the whole gain or loſs;
So is each particular Product to that particular mans gain or loſs.

So then the Rule is wrought as that without time, as by Examples following will appear.

Queſtion I.

William, *Robert* and *Thomas*, make a Stock of 10000 *l*. *William* puts in 4888 *l*. for three Months; *Robert* puts in 3000 *l*. for 6 Months; and *Thomas* puts in 3000 *l*. for 8 Months;

months; with this they gain 2000 *l.* what
each party have of the gain?

First, for *William*, multiply 4000 *l.* his
ck, by 3 his time, it makes 12000, which
be accounted his particular Stock.

Secondly, for *Robert*, multiply 3000 his
ck, by 6 his time, it makes 18000 for
Stock.

Lastly, for *Thomas*, multiply 3000 his
ck, by 8 his time, it produceth 24000,
his Stock; these three added together,
ke 54000 *l.* which is the general Stock;
en say,

For *William*.

If 54000 give 2000, what 12000?
nswer, $444\frac{24000}{54000}$.

Then for *Robert*.

If 54000 give 2000, what 18000?
nswer, $666\frac{36000}{54000}$.

Lastly, for *Thomas*.

If 54000 give 2000, what 24000?
nswer, $888\frac{7000}{54000}$.

The

The three Fractions being reduced to le
ſer terms will be 444 $\frac{4}{37}$, 666 $\frac{6}{37}$, and 888 $\frac{8}{37}$
which altogether makes 2000 *l.* as the
ought, and as by the work following do
appear.

William 4000 *l.* for 3 Months,

3

12000 *William*'s Stock.

Robert 3000 *l.* for 6 Months,

6

18000 *Robert*'s Stock.

Thomas 3000 *l.* for 8 Months,

8

24000 *Thomas*'s Stock.

These added make { 12000, 18000, 24000 }

The general Stock. 54000

Then

Then for Williams *share, say,*

If 54000 gain 2000 *l.* what 12000?

2000

24000000

x (2
xxx (4
$xxxxxx$ (000 (444 $\frac{24000}{54000}$
$xxxx000$
xx *William's* share.

Then for Robert's *share.*

If 54000 gain 2000 *l.* what 18000?

2000

36000000

x (3
xxx (6
$xxxxxx$ (000 (666 $\frac{36000}{54000}$
$xxxxxx$
xx *Robert's* share.

Lastly, for Thomas's *share.*

If 54000 gain 2000 *l.* what 24000?

2000

48000000

x (4

4 (4
488 (8
48000 (000 (888 $\frac{48000}{54000}$
5444000
55 *Thomas*'s share.

Which Fractions being reduced, and three shares added together, make 2000 which proves the work to be true.

444 $\frac{4}{9}$
666 $\frac{6}{9}$
888 $\frac{8}{9}$
2000

Question 2.

Three Farmers, *A. B.* and *C.* lay o 1000 *l.* to Stock their ground with Catt of which *A.* put in 200 *l.* for 6 years, had 300 *l.* going for four years, and *C.* 500 for 2 years; at the end (by unseasona times) there was lost 200 *l.* which ma the remain of their Stock but 800 *l.* wh was each mans Loss?

Multiply 200 by 6, it gives 1200. Li wise 300 by 4, it gives 1200. Lastly, 5 by 2, the Product is 1000; all these 3400 for the Joint-Stock.

Then first for *A.*

Say, if 3400 lose 200, what 1200? Answer, 70 $\frac{2000}{3400}$ for *A.* to which *B.* is also equal, because their Stock and time together are equal.

Therefore, for C.

Say, if 3400 lose 200, what 1000? Answer, 58 $\frac{1800}{3400}$. So the 3 shares are 70 $\frac{20}{34}$ 70 $\frac{10}{34}$ and 28 $\frac{28}{34}$, equal to 200.

Now because *A.* put in 200 *l.* and lost 70 $\frac{10}{34}$, substract his loss from his Stock, remains 129 $\frac{14}{34}$.

And so doing for *B*, his remain will be 289 $\frac{14}{34}$.

And for *C*, his remain is 441 $\frac{6}{34}$.

Now these three remains, 129 $\frac{14}{34}$, 289 $\frac{14}{34}$, and 441 $\frac{6}{34}$, make up 800 *l.* which was the whole remain.

Question 3.

A. Rents a Close for a Year, to pay 80 *l.* he puts into it 200 Sheep: 2 Months after *B.* puts 40 Sheep in; and 5 Months after that *C.* puts in 100 Sheep; how much must every one pay of the Rent?

Multiply

Multiply 200 by 12, it produceth 2400
And 40 by 10, produceth 400
Lastly, 100 by 5 produceth 500
In all 3300

Then for A.

If 3300 pay 80, what 2400? Answer, $58\frac{600}{3300}$.

Then for B.

If 3300 pay 80, what 400? Answer, $9\frac{2300}{3300}$.

And for C.

If 3300 pay 80, what 500? Answer, $9\frac{400}{3300}$.

The whole numbers make 79, and the Fractions make 1, In all 80.

Question 4.

Two Merchants *A.* and *B.* Company; *A.* puts in 450 *l.* the first of *January*, *B.* puts in 750 *l.* the first of *May*, at the Years end they have gained 100 *l.* what is either's gain?

A. his money, *viz.* 450 *l.* continued in Stock the whole Year, or 12 Months, wherefore multiply 450 by 12, and it maketh 5400.

B.

B. his 750 *l.* was in but 8 Months, wherefore multiply it by 8, and it produceth 6000. These two added together make 11400. This done, Say by the Golden Rule,

As 11400. the whole Stock and time
Is to 100 *l.* the whole Gain,
So is 5400 *A.* his Stock and time
To 47 $\frac{7}{19}$ *l.* for *A.* share.

Then for B. *share.*

As 11400 : to 100 *l.* :: So 6000 : to 52 $\frac{12}{19}$.

As in the work appears.

I. For *A.*

11400	100	5400
~~1~~ (4		100
8~~7~~		540000
~~104~~ (2		
~~5400~~ (~~00~~ (47 $\frac{42}{114}$ *A.* share.		
~~114400~~		
~~11~~		

l.	*s.*	*d.*	*q.*
47	7	4	1 $\frac{13}{19}$.

II. *For* B. *share.*

11400	100	6000
~~1~~		100
~~3~~ (7		600000
~~158~~ (2		
~~600000~~	$52\frac{12}{19}$ for *B.* share.	
~~114400~~		
~~11~~		

	l.	*s.*	*d.*	*q.*
	52	12	7	$2\frac{6}{19}$

So that	*l.*	*s.*	*d.*	*q.*
A had for his share	47	7	4	$1\frac{13}{19}$
B. had	52	12	7	$2\frac{6}{19}$
In all	100	0	0	0

Equal to the whole Gain.

A. and *B.* Company for a Year.

A. puts in 640 *l.* *January* 1. But *B.* cannot put in till *April* 1. What money must *B.* then put in, that at the years end he may have equal profit with *A*?

Multiply *A.* money by 640 *l.* by its time 12 Months, it makes 7680, and so much should *B.* put in. But seeing he cannot put in till 3 Months after, his Stock will be in but 9 Months; wherefore, divide 7680 by 9, and you shall have in the Quotient $853\frac{1}{3}$, and so much ought *B.* to put in the first of *April*, and to receive the half profit or loss at the Years end.

CHAP. XVIII.

The Rule of PRACTICE.

THE Rule of Practice is nothing else but a compendium of the *Direct Rule of Three.*

For the ready performance of this Rule, you are to know readily the even parts of one Penny, of one Shilling, of one Pound, *&c.* Which these Tables following will plainly shew, and they must be learned by heart, which will be easie to do when you are any way accustomed to use them.

The even parts of a Penny.

1, 2, 3 } Farthings is the { $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ } of a Penny.

The even parts of a Shilling, are Pence.

6, 4, 3, 2, 1 } is the { $\frac{1}{2}$, $\frac{1}{3}$, $\frac{1}{4}$, $\frac{1}{6}$, $\frac{1}{12}$ } of a Shilling.

This Table is thus to be read and learned.

Six pence is the $\frac{1}{2}$ of a Shilling.

Three pence is the $\frac{1}{4}$ of a Shilling.

One penny is the $\frac{1}{12}$ of a Shilling, and

The manner of using this and the following Tables, will appear by the following Questions.

At six pence the Yard, what are 7632 Yards worth?

Six pence being the one half of a Shilling, you must therefore take the half of 7632, and it is 3816, which are so many Shillings, that Divide by 20 (which is done by cutting off the last Figure towards the right hand, and taking the half of the other Figures) there is 190 *l.* 16 *s.* which is the price of 7632 pound of any Commodity at 6 pence the pound.

See the work.

At 6 *d.* the pound, what 7632 pound?

6 *d.* $\frac{1}{2}$ — 3816

l.	*s.*	*d.*
190	16	0

At 4 *d.* the Yard, what 9763 Yards?

Four pence being $\frac{1}{3}$ of a Shilling, take $\frac{1}{3}$ of the number.

At

At 4 *d.* the Yard, what 9763 Yards?

4 *d.* $\frac{1}{2}$ | 3521|4 | 4 *d.*

l.	*s.*	*d.*
162	14	4

Here when you had taken the third part of 9763, it produced 3254 Shillings, and one remaining, which one remaining, representing $\frac{1}{3}$ of a Shilling, which is 4 *d.* and therefore set it down: Alſo when you took the half of 325, it produced 162, and one remaining, which one that remained repreſenteth 10 *s.* which being joined to that 4 that is cut off, maketh it 14 *s.* So the whole price comes to be 162 *l.* 14 *s.* 4 *d.*

I have been the larger in theſe two firſt Examples, becauſe I intend only to ſet down the other that follow, and leave them to your own Practice.

At 3 *d.* the Gallon, what 3795 Gallons?

3 *d.* $\frac{1}{4}$ | 948|8 | 9 *d.*

l	*s.*	*d.*
47	8	9

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At 2 *d.* the pound, what 97625 pound?
2 *d.* $\frac{1}{6}$ 162|7 10 *d.*

l.	*s.*	*d.*
81	7	10

At 1 *d.* the Ounce, what 6725 Ounces?
1 *d.* $\frac{1}{15}$ 56|0 5 *d.*

l.	*s.*	*d.*
28	0	5

Uneven parts of a Shilling.

The uneven parts of a Shilling are 5 *d.* 7 *d.* 9 *d.* 10 *d.* and 11 *d.* Wherefore if any Question be proposed, where any of these uneven numbers is the price, you must

		d.	*d.*
For	5	Pence take	3 and 2
	7		4 and 3
	9		6 and 3
	10		6 and 4
	11		4 and 4 and 3 *d.*

As by the Questions following will appear.

At

At 5 *d.* the Yard, what 758 Yards?

3 *d.* $\frac{1}{4}$
2 *d.* $\frac{1}{6}$

189	6 *d.*
126	4 *d.*
31|5	10 *d.*

l.	*s.*	*d.*
15	15	10

At 7 *d.* the pound, what 563 pound?

4 *d.* $\frac{1}{3}$
3 *d.* $\frac{1}{2}$

187	8 *d.*
140	9 *d.*
33|8	5 *d.*

l.	*s.*	*d.*
16	8	5

At 8 *d.* the Ell, what 112 Ells?

4 *d.* twice $\frac{1}{3}$

37	4 *d.*
37	4 *d.*
7|4	8 *d.*

l.	*s.*	*d.*
3	14	8

At 9 *d.* the dozen, what 498 dozen?

$6\frac{1}{2}$
$3\frac{1}{4}$

249	*d.*
124	3
37|3	3

l.	*s.*	*d.*
18	13	3

At 10 *d.* the Groſs, what 9769 Groſs?

$6\frac{1}{2}$

4884	6 *d.*
3256	4
814|0	10

l.	*s.*	*d.*
407	0	10

At 11 *d.* the Quart, what 7895 Quarts?

$4\frac{1}{2}$
$4\frac{1}{3}$
$3\frac{1}{4}$

2631	8 *d.*
2631	8
1973	9
723|7	1

l.	*s.*	*d.*
361	17	1

The

The even parts of a Pound Sterling, or Twenty Shillings.

The even parts of a pound or 20 *s.* are, 10 *s.* 5 *s.* 4 *s.* 2 *s.* 1 *s.* to which may be added 6 *s.* 8 *d.* and 3 *s.* 4 *d.* and 2 *s.* 6 *d.* some others, too many here to enumerate, or to trouble the Reader to retain in memory: but those sufficient for use this Table following declares.

10		
6 8 *d.*		
5		
4	is the	of a Pound.
3 4 *d.*		
2 6 *d.*		
2		
1		

At 10 *s.* the Yard, what 372 Yards?

10 $\frac{1}{2}$ 186

At 6 *s.* 8 *d.* the pound, what 479 pound?

s.	*d.*		*s.*	*d.*
6	8 $\frac{1}{3}$	159	13	4

At 5 *s.* the Piece, what 984 Pieces?
5 ¼ 246 *l.*

At 4 *s.* the Ell, what 762 Ells?
4 ⅕ 152 *l.* 8 *s.*

At 3 *s.* 4 *d.* the Yard, what 9621?
3 *s.* 4 *d.* ⅙ 1603 *l.* 10 *s.*

At 2 *s.* 6 *d.* the Pound, what 9653 pound?
2 *s.* 6 *d.* ⅛ 1206 *l.* 12 *s.* 6 *d.*

At 2 *s.* the Gallon, what 144 Gallons?
2 1/10 14 *l.* 8 *s.* 0 *d.*

At 1 *s.* the Ell, what 6957|3 Ells?
1 *s.* 1/20 3478 *l.* 14 *s.* 0 *d.*

Uneven parts of a pound Sterling, or twenty Shillings.

The uneven parts of twenty Shillings are, 3, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19 *s.*

Wherefore, if any Queſtion be put at any of theſe Rates, you muſt do as in the uneven parts of a Shilling, take two ſuch even parts

25

as will make up your uneven part, As this Table shews.

For *Sh.*	Shillings take *Sh.*	*Sh.*
3	2 and	1
6	4	2
7	5	2
8	4	4
9	5	4
11	10	1
12	10	2
13	10	2 and 1
14	10	4
15	10	5
16	10	5 and 1
17	10	5 and 2
18	10	5 and 3
19	10	5 and 4

As by some Questions following.

At 16 *s.* the Piece, what 7569 Pieces?

10 *s.* $\frac{1}{2}$	3784	10
5 $\frac{1}{4}$	1892	5
1 2 $\frac{1}{8}$	378	9
	6055	4

At 19 *s.* the Yard, what 2659 Yards?

10 ½	1329	10 *s.*
5 ¼	664	15
4 ⅓	531	16
	2516	01

At 13 *s.* 7 *d.* 3 *q.* the Gallon, what 79 ½ Gallons?

	l.	*s.*	*d.*	*q.*
5 *s.* ¾	19	15	0	0
4 *s.* ⅓	15	16	0	0
4 *s.* ⅓	15	16	0	0
4 *d.* ⅓	1	6	4	0
3 *d.* ¼	0	19	9	0
2 *q.* ¼		3	3	2
1 ⅛		1	7	3
The ½ Gallon		6	9	3 ½
In all	54	4	10	0 ½

Many other Questions might be added, but let these suffice.

CHAP.

1. Two Barter, the one hath 420 poun. of *Mace*, at 12 *s.* the pound, the other hat *Broad-Cloath* at 10 *l.* 10 *s.* the Piece, ho many *Broad-Cloths* ought he to give for his *Mace*? *Answer*, 24.

Mace.			*Broad-Cloth.*			
p.	*s.*	*p.*	*l.*	*s.*	*B.c.*	*s.*
1	12	420	10	10	1	504
		12	20			
		840	210			504
		420	x8			
		5040	5040 (24 Broad-C			
			xxoo			
		252 *l.*	xx			

2. Two

2. Two Barter; the one hath 32 Pieces of *Canvas*, at 16 *l.* 7 *s.* the Piece, the other hath *Baise* at 2 *s.* 3 *d.* the Ell, how many Ells of *Baise* for all his *Canvas*? *Answer*, 4650 $\frac{2}{3}$ Ells.

Canvas.

Can.	*l.*	*s.*
1	16	07
	20	
	327	
	32	
	654	
	981	
	10464	

Can.
32

523 *l.* 4 *s.* 0 *d.*

Baise.

s.	*d.*
2	3
12	
27	

Ell.	*l.*	*s.*
1	523 $\frac{1}{3}$	4
	20	
	10464	
	12	
	20928	
	10464	
	125568	

x
x5/3
473 (1
x25568 (8 (4650 $\frac{2}{3}$
x7777
xxx

3. Two

3. Two Barter, the one hath 4650 $\frac{2}{3}$ Ells of *Baise*, at 2 *s.* 3 *d.* the Ell, the other hath *Canvas* at 16 *l.* 7 *s.* the Piece: how many Pieces of *Canvas* for 4650 $\frac{2}{3}$ Ells of *Baise*?

Answer, 32 Pieces.

Baise.

Ell.	*s.*	*d.*	*Ell.*
1	2	3	4650 $\frac{2}{3}$
3	12		3
3	27		13952
			27
			27904
			376704

xxxx
376704 (125580
333333

x
274
x29568 (1046|4
xxxxxx
xxxx

l.	*s.*	*d.*
523	4	0

Canvas.

l.	*s.*	*Pi.*	*l.*	*s.*
16	7	1	523	4
20			20	
07			10464	
32				
327				

6x
x8y
x0464) 32 Pieces.
3x77
3x

4. Two

4. Two Barter, the one hath *Indigo* at 4 *s.* *per* Pound, ready money, but in Barter he will have 4 *s.* 9 *d.* the other *Kerſie* at 3 *s.* 6 *d.* the Yard ready money, at what Price muſt he Rate his *Kerſie* in Barter, that he may be no loſer?

Say by the Rule of Three,

If 4 *s.* in Barter give 9 *d.* what ſhall 3 *s.* 6 *d.* give?

s.	*d.*	*s.*	*d.*
4	9	3	6
12		12	
48		42	
		9	
		378	

(4
9 (2
378 ($\frac{42}{48}$ or $\frac{7}{8}$ *viz.* 3 $\frac{1}{3}$.
48

	s.	*d.*	*q.*
	3	6	0
	0	7	$3\frac{1}{3}$
The price of the *Kerſies* by the Yard muſt be	4	1	$3\frac{1}{3}$

5. Two

5. Two Barter, One hath 120 Yards of Broad-Cloth, for which in ready money he will have 15 *s.* *per* Yard, but in Barter he will have 18 *s.* *per* Yard. The other hath Hops at 4 *l.* 5 *s.* the C. ready money, how must he rate his Hops, and how many C. of Hops must he give for all his Broad-Cloath?

First, 120 Yards of Broad-Cloth at 18 *s.* (which is the price he will have *per* Yard in Barter) comes to 108 *l.*

Secondly, if 15 *s.* ready money, gain 3 *s.* in Barter, what shall 4 *l.* 5 *s.* gain?

The Answer will be 17 *s.* wherefore he must rate his Hops in Barter at 5 *l.* 2 *s.* *per* C.

Thirdly, say, If 5 *l.* 2 *s.* buy 1 C. of Hops, how many C. shall I buy for 108 *l.*? Multiply and Divide, and you shall find 21 *C.* 0 *qr.* 19 $\frac{19}{51}$ *l.* And so many Hops must he give for his 120 Yards of Cloath.

l.	*s.*	*c.*	*l.*	(1
5	2	1	108	*xx* (8 C.
20			20	*xxøø* (21 $\frac{9}{51}$.
120			2160	*xøxx*
				xx

CHAP.

CHAP. XX.

Of ALLIGATION.

THis Rule teacheth how to mix divers things, as Grains, Spices, Metals, Woolls, *&c.* of different prices together, so that a Quantity may be made up of those Severals, of any Price and any Weight required.

Question 1.

A Grocer hath four several sorts of Spices, one of 2 *d.* another at 3 *d.* a third at 5 *d.* and a fourth at 6 *d.* the Ounce, of these he would make a Mixture to contain 50 Ounces, and that each Ounce should be worth 4 *d.*

Place the prices of the several prices one under another as you see here in the Margine, then with a crooked line link or join two of them together with this Condition, that you always linck a greater and a lesser, as here I have done 2 and 6, and 5 and 3, and not 2 and 3, and 5 and 6.

This

This done, place the price required, *viz.* 4 *d.* by it ſelf towards the left hand, and towards the right hand note the ſeveral differences between the price of an Ounce of every particular Spice, and of the Price required, as here the difference between 2 *d.* and 4 *d.* is 2 *d.* which I place (not againſt 2 *d.* the firſt price I took, but) againſt 6 *d.* which is lincked to it, likewiſe I take the difference between 3 *d.* and 4 *d.* which is 1, and ſet that againſt 5 *d.* which is lincked with 3 *d.* Again, I take the difference between 6 *d.* and 4 *d.* which is 2 *d.* and ſet that againſt 2 *d.* which is lincked with 6 *d.* And laſtly, I take the difference between 5 *d.* and 4 *d.* which is 1, and place that againſt 3 *d.* which is lincked with 5 *d.* then I add all theſe differences together, and they make 6, which I place under them, and then the work will ſtand as is before expreſſed. Now for the working of this Queſtion, or any other of the like nature, this is

The RULE.

Multiply the ſumm of the whole Maſs to be made, by any of the particular differences, and divide that Product by the Summ of all the Differences, the Quotient ſhall be the juſt quantity of that particular kind, whoſe price ſtandeth againſt that difference you multiplied with.

Example.

Example.

First, Multiply 50 Ounces (the whole *Mass*) by 2, the difference which ſtands againſt 2 *d.*) and it makes 100, this divided by 6, (the ſumm of all the differences) gives $10\frac{4}{6}$ for the number of Ounces that muſt be taken of the price of 2 *d.*

Secondly, multiply 50 the whole *Maſs* by 1, the difference ſtanding againſt 3 *d.* it makes 50, which divide by 6, the ſumm of the differences, it gives $8\frac{2}{6}$ and ſo many Ounces muſt be taken of the price of 3 *d.*

Now ſeeing the differences ſtanding againſt 5 *d.* and 6 *d.* are 1 and 2, the ſame quantity of Ounces as was taken for 3 *d.* muſt be taken alſo for 5 *d.* and the like quantity of that of 6 *d.* as was of 2 *d.* As by the work following will appear.

	Oun.			*Ou.*	
6	50	2	6	50	1
	2				
	100		2	*Ou.*	*d.*
4	(4 *Ou.*	*d.*	50	(8 $\frac{2}{6}$ of	3
100	(16 $\frac{4}{6}$ of	2	0		
60					

By

By this work you may perceive that you must take 16 Ounces $\frac{4}{6}$ of the Spice of 2 *d.* the Ounce. And also that you must take 8 Ounces, $\frac{2}{6}$ of that of 3 *d.* And because the differences against 5 *d.* and 6 *d.* are the same with those against 2 *d.* and 3 *d.* therefore take $8\frac{2}{6}$ Ounces of that of 5 *d.* and $16\frac{4}{6}$ Ounces of that of 6 *d.* And these four added together will make up 50 Ounces, the required Mass, which may thus be easily proved, for,

Ounces		*d.*	
$16\frac{4}{6}$	of that of	2	the Ounce.
$8\frac{2}{6}$		3	
$8\frac{2}{6}$		5	
$16\frac{4}{6}$		6	

In all 50 Ounces.

But here it is to be observed, That there was no necessity of linking the numbers as they were before linked, but may be varied at pleasure, for whereas before I linked 2 and 6, and 3 and 5, I might have linked 2 and 5, and 3 and 6. But by this diversity of linking, there will follow a diversity of answer to the question, but both of them true, as may appear by the following Work.

Example.

Example.

Let the Numbers be linked as here you ſee, the common price ſet on the left hand, and the ſeveral Maſs on the right hand, and the ſumm of the difference under them, then multiplying 50 by 1, the Product is 50, which divided by 6, the quotient is $8\frac{2}{6}$, and ſo much muſt be taken of the price of 2 *d.* and the reſt as by the following operations doth appear.

	d.	
	2	1
d.	3	2
4	5	2
	6	1
ſumm	6	

Oun.

6 50 1

(2

5ø (8 $\frac{2}{6}$ of 2 *d.*

6

Oun.

6 50 2

2

100

4 (4

xøø (16 $\frac{4}{6}$ of 5 *d.*

66

Oun.

6 50 2

2

100

4 (4

xøø (16 $\frac{4}{6}$ of 3 *d.*

66

Oun.

6 50 1

(2

5ø (8 $\frac{2}{6}$ of 6 *d.*

6

The

The Numbers being lincked as here you must take

$$\left.\begin{matrix} 8\frac{2}{6} \\ 16\frac{4}{6} \\ 16\frac{4}{6} \\ 8\frac{2}{6} \end{matrix}\right\} \text{Ounces of} \left\{\begin{matrix} 2 \\ 3 \\ 5 \\ 6 \end{matrix}\right\} \text{the Ounce.}$$

In all 50 Ounces as before. But whereas before you took

Ounces

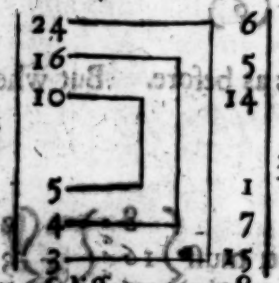
$$\left.\begin{matrix} 16\frac{4}{6} \\ 8\frac{2}{6} \\ 8\frac{2}{6} \\ 16\frac{4}{6} \end{matrix}\right\} \text{of} \left\{\begin{matrix} 2 \\ 3 \\ 5 \\ 6 \end{matrix}\right\} \begin{matrix} \text{you must} \\ \text{now take} \end{matrix} \left\{\begin{matrix} 8\frac{2}{6} \\ 16\frac{4}{6} \\ 16\frac{4}{6} \\ 8\frac{2}{6} \end{matrix}\right\} \text{of} \left\{\begin{matrix} 2 \\ 3 \\ 5 \\ 6 \end{matrix}\right.$$

Example 2.

A Founder hath six sorts of Metals, of several prices, one at two Shillings, another at one Shilling four pence, a third at ten pence, a fourth at five pence, a fifth at four pence, and a sixth at three pence the pound; of these he would make a mixture of thirty pound weight, so that the price of each pound weight should be nine pence; how much must he take of each sort?

Having placed the Numbers and lincked them together, and their differences, and the

ſumm of theſe differences, diſtinctly as hath been ſhewed before, and as may be ſeen by the Example following, the manner of performing the Work, will be as in the former Queſtion,



ſumm of differences 38

Here (according to your Rule) you muſt multiply 30 (the whole Maſs to be made) by 6 (the firſt difference) the Product is 180, which divide by 38 the ſumm of all the differences, and the quotient will be 4 $\frac{28}{38}$ and ſo many Pounds muſt be taken of the ſort of Metal of 2 *s.* the Pound, as by the work appears; and the like courſe muſt be taken for the reſt.

1. For that of 2 *s.* the Pound.

lib.

38 30 6

6

180

2

6 (8

38 (4 $\frac{28}{38}$ for that of 2 *s.*

38

2. For that of 1 *s.* 4 *d.*

lib.

38 30 5

5

150

3

6 (6

38 (3 $\frac{36}{38}$ or that of 1 *s.* 4 *d.*

38

3. For that of 10 *d.*

lib.

38 30 4

4

120

3 (6

120 (3 $\frac{6}{38}$ for that of 10 *d.*

38

4. For that of 5 *d.*

lib.

30 30 1

0 $\frac{1}{38}$ for that of 5 *d.*

5. For that of 4 *d.*

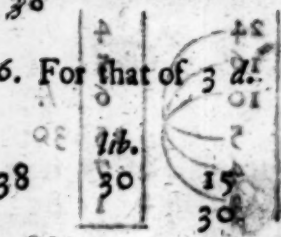
lib.

38 30 7

7

210

for that of 4 *d.*



6. For that of 3 *d.*

	lib.	
38	30	15
		30
		450

4.	28
3.	36
3.	6
0.	30
5.	20
11.	32
26.	152

These particular quotients being added together (the Denominators of the Fractions being omitted) as in the Margin, their summ is 26 *lib.* and $\frac{152}{38}$ of a *lib.* divide therefore 152 by 38, and the quotient will be 4, which add to 26, and it makes 30 *lib.* the whole Mass inquired.

The ſame Queſtion Reſolved, the Numbers being otherways lincked.

	24	4	
	16	5	
d.	10	6	*l.*
9	5	15	30
	4	7	
	3	1	
			30

[I.]

38 30 4

4

120

3 (6 *d.*

~~120~~ (3 $\frac{2}{15}$ for that of 24

38

[II.]

[II.]

38 30 5

5

150

(3

~~6~~ (6

~~150~~ (3 $\frac{36}{38}$ for that of 10 *d.*

~~38~~

[III.]

38 30 6

6

180

(2

~~6~~ (8 *d.*

~~180~~ (4 $\frac{28}{38}$ for that of 10

~~38~~

[IV.]

38 30 15

30

450

(3
4
27 (2
450 (11 $\frac{10}{11}$ for that of 5 d.
388
2

[V.]

38 30
7
210

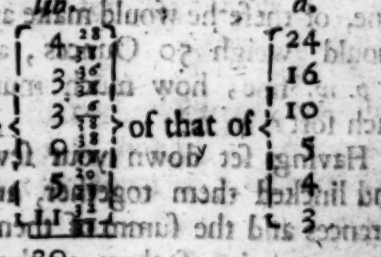
(2
8 (0
228 (5 $\frac{20}{38}$ for that of 4 d.
38

[VI.]

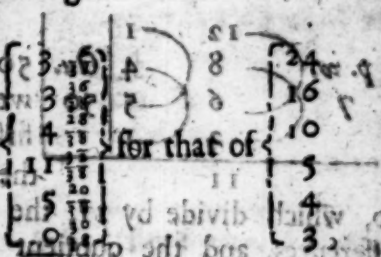
38 30 1
0 $\frac{30}{38}$ for that of 3 d.

By the different linking of the numbers you may now see what difference ariseth in the quantities of the several sorts, for by the

First linking.



Second linking.



Question 3.

A Goldsmith hath four sorts of Silver, one of 12 *p. w.* fine, another of 8 *p. w.* fine, a third of 6 *p. w.* fine, and a fourth of 3 *p. w.* fine, of these he would make an Ingot which should weigh 50 Ounces, and should be 7 *p. w.* fine; how much must he take of each sort?

Having set down your several numbers and linked them together, and set the differences and the summ of them, as also the common price of them on the left, and the Ingots weight on the right hand.

First multiply 50 the Ingots weight by 1 the first difference, the Product is 50, which divide by 11, the summ of the differences, and the quotient will be $4\frac{6}{11}$, and so many Ounces must be taken of that Silver of 12 *p. w.* fine.

Do

Do so for all the rest as you see done in the Example following.

Ou.

11 50 1

~~1~~ (6 *p. w.*

~~50~~ (4 $\frac{6}{11}$ for that of 12.

~~11~~

And seeing that the difference which stands against 3 *p. w.* fine is 1, you need not make it, but set down 4 $\frac{6}{11}$ Ounces for that also.

For 8 *p. w.* fine.

11 50 4

4

200

~~1~~

~~19~~ (2

~~200~~ (18 $\frac{2}{11}$ for 8 *p. w.*

~~111~~

~~1~~

For

For 6 p. m. fine.

$4\frac{6}{11}$	11	50	5
$18\frac{2}{11}$		5	11
$22\frac{3}{11}$		250	
$4\frac{6}{11}$			
50			

8) 250 (22 $\frac{3}{11}$ for that of 6 p.m.

These four Numbers $4\frac{6}{11}$, $18\frac{2}{11}$, $22\frac{3}{11}$ and $4\frac{6}{11}$ added together, make 50, equal to the Ingots weight, which was required.

CHAP.

CHAP. XXI.

Various Questions to exercise most parts of Arithmetick.

1. A Butcher had 450 *l.* to buy several sorts of Beasts, *viz.* Beev's at 30 *s.* a piece, Hogs at 10 *s.* a piece, Sheep at 6 *s.* a piece, Calves at 4 *s. per* Calf, and Lambs at 2 *s. per* Lamb, an equal number of each. How many must he buy of every sort?

The operation is thus, 450 *l.* is 9000 *s.* and the several summs added together amount to 52. therefore if 9000 be divided by 52, the Quotient will be 173 (omitting the remainder) and so many of each sort must the Butcher buy; and he had 4 *s.* remaining in his hands, which may be prov'd by Addition as followeth.

	l.	*s.*	*d.*
For the Beeves 173 times 30 *s.* is equal to	259	10	00
And 173 times 10 *s.* for the Hogs	86	10	00.
Also 173 times 6 *s.* for Sheep, is	51	18	00.
So 173 times 4 *s.* for Calves, is	34	12	00.
And 173 times 2 *s.* for Lambs, is	17	06	00.
Total is	449	16	00.

Less by 4 *s.* than the Butcher Received to lay out as aforesaid.

2. In

2. In 460 *l.* Sterling, how many Shillings, six pences, four pences (or groats,) and two pences, of each a like number may be found therein? Answer, 4600 of each, as may be prov'd by operation, according to the method in the former Question. For 12 *d.* + 6 + 4 *d.* + 2 *d.* = 24 *d.* and 460 *l.* is = to 110400 pence, which divided by 24 Quotes 4600 the Answer.

The proof confirms the same.

	l.	*s.*	*d.*
For 4600 Shillings is = to	230	00	00.
And 4600 Six pences is = to	115	00	00.
Also 4600 Groats is = to	076	13	04.
And 4600 two pences = to	038	06	08.
The Total	460	00	00.

3. A Footman going every day 26 Miles, the eighth day after there followeth another man that goes 36 miles a day, when (or in what time) shall he over-take the former? 36 − 26 = 10 : 8 :: 26 : 20 $\frac{4}{5}$. That is the difference of 36, and 26, is 10. Then say, if 10 gives 8, what : : 26. Answer 24 $\frac{4}{5}$. *viz.* near 25 dayes.

4. There was a Vessel which contained 36 Barrels, set under a Cock that run or dropt in an hour 16 Barrels, and this Vessel run

run or dropt another way 6 Barrels in an hour, how many hours shall this Vessel be filling? Answer 3 hours $\frac{3}{7}$ for $16 - 6 = 10$. Then $10 : 1 :: 36 : 3\frac{3}{7}$.

5. If 30 Bushel of Seeds yield in one Year 360 Bushel, how many will 80 Bushel yield in seven Years? Answer 6720 Bushels, which may be proved and wrought by the Golden Rule, compounded of 5 numbers, or the double Rule of Three.

6. If 6 Mowers Mow 45 Acres in 5 days, how many Mowers will Mow 300 Acres in 6 dayes? Answer 33, and somewhat more, by the double Rule of three.

7. If in 10 dayes of 12 hours long a man may travel 300 Miles, in how many dayes of 16 hours long may he travel 500 Miles? Answer 12. 5.

8. When one Shillings worth of Wine satisfies 8 Men at a Meal, when Wine is at five pence a Quart, how many Men will one Shilling and 8 pence suffice when Wine is at 4 *d.* a Quart? Answer 20.

When the Tun of Wine is at 12 *l.* price, and 3 *l.* worth thereof (or a Quarter of

that

that Tun) will ſatisfy 16 Men, during 4 dayes, when the dayes are but 9 hours long? How many pounds worth of Wine, when 'tis 24 *l. per* Tun, will ſerve for 10 Men, during 12 dayes, when the day is 8 hours long? Anſwer 10 *l.* worth. Operation.

men.	*hours.*	*pounds.*
16 —	36 —	6
10 —	96 —	10

12 : 3 :: 24 : 6 :

Then 8 X 12 = 96 & 4 X 9 = 36 hours. And 6 X 10 X 96 = 5760 & 16 X 36 = 576 the Diviſor, and the aforeſaid 5760 the Dividend. Then $\frac{5760}{576}$ = 10 the Quote, or Anſwer.

Note, That this Mark + ſignifies more, or Addition, and this — loſs, or Subſtraction, this X Multiplication, and this $\frac{12}{3}$ 4 form Diviſion. This proportion : : : : 6.

10. A Butcher bought an Ox, weighing beſides Skin and Legs, 808 Pounds, which coſt 12 *l.* He ſold the Skin and Legs for 22 *s.* 4 *d.* and 16 Stone and $\frac{1}{2}$ of Tallow, at 5 *d.* $\frac{1}{2}$ a pound, what doth a Stone of Beef ſtand him in, and how muſt he ſell a Stone of Beef to gain 40 *s.* in the whole Ox? Anſwer, a Stone of Beef ſtands or coſt him,

28 *d.* $\frac{1}{2}$

28 *d.* $\frac{1}{4}$, *viz.* 2 *s.* 4 *d.* $\frac{1}{4}$, and he must sell every Stone for 47 *d.* $\frac{1}{2}$. Skin and Legs 22 *s.* 4 *d.* Tallow 5 *l.* 4 *s.* 3 *d.* $\frac{1}{2}$, in all 6 *l.* 6 *s.* 7 *d.* $\frac{1}{4}$, which subtracted out of 12 *l.* leaves 5 *l.* 13 *s.* 4 *d.* $\frac{3}{4}$, or 5443 Farthings. $898 - 227\frac{1}{2} = 670\frac{1}{2}$. Then if 670. 5 : 5453 Far. :: 14 : 113 Far. 64, or 28 *d.* 41. Then if 12 *l.* 40 *s.* :: 28, 41 : 47 *d.* 35 to sell the Stone of Beef.

11. A Man buyeth Stuff for 22 *s.* 6 *d.* the piece ready money, and would sell it again for 24 *s.* the piece, what time may he forbear his money, and yet gain after the rate of 9 *l. per Cent.* for 12 Months? Answer 8 Months 8 Days.

12. A person buyeth 20 Yards of Sattin for 12 *l.* 10 *s.* ready money; for how much more than it cost may he sell it *per* Yard, giving 2 Months for payment, to gain after the rate of 10 *l. per Cent.* for 12 Months? For Answer, because the Position is of 20 Yards, and the Question but what he may raise in one Yard only, and not in the whole 20 Yards. First find the price of 1 Yard thus; If 20 gives 12 *l.* 5 :: what 1: Answer, 605. or 12 *s.* 6 *d.*

13. A

13. A Town is Besieged, wherein is 3000 Souldiers, who have provision sufficient for two Months, but they can expect no relief till six Months; How many Souldiers should the Governour Disband, that the Provision or Victuals may last so long? Answer 2000.

14. If 5 Cannons in 2 days spend 60 Barrels of Powder, what will 14 Cannons spend in 5 Days? Answer 420.

15. If one Trooper for one Months pay receive 60 Shillings, or 3 *l.* what will pay 4000 Horse for 9 Months, Answer 108000 *l.*

16. Three Men gain'd 120 *l.* whereof *A.* is to have 8 *l.* as oft as *B.* had 9 *l.* and as oft as *B.* had 9 *l.* *C.* had 7 *l.* What was each Mans part? $8 + 9 + 7 = 24$. Answer *A.* 40. *B.* 45. and *C.* 35. $= 120$. As 24 : 120 :: so 8 *&c.* and so :: 9. *&c.* and so :: 7. *&c.*

17. Three Men made a Stock by which they gain'd 400 *l.* *A.* was to have 4 *l.* as oft as *B.* had 6 *l.* and as oft as *B.* had 9 *l.* *C.* had 7 *l.* what must each man have for his share? Answer, *A.* had 66 *l.* $\frac{48}{72}$. *B.* 100. *C.* 233 $\frac{24}{72}$.

18. To

18. To divide 1 Shilling between 3 men, the first to have $\frac{1}{2}$, the second $\frac{1}{3}$, and the third man $\frac{1}{4}$; What shall each Man have? The $\frac{1}{2}$ of 12 = 6. $\frac{1}{3}$ of 12 = 4. $\frac{1}{4}$ of 12 = 3. Now 6 + 4, + 3, = 13. Then say, If 13 give 12 what 6? If 13 give 12 what 4? and if 13 gives 12 what 3? and you have every Mans share, which added all together makes up the 12 again; and thus every Man shall have his particular part.

19. *A. B. C, D.* bought a Mannory which cost 3000 *l.* *A.* paid $\frac{1}{2}$ and 6 *l.* more, *B.* $\frac{1}{3}$ + 12 *l.* *C.* $\frac{1}{4}$ — 8 *l.* *D.* $\frac{1}{5}$ + 20 *l.* what did each Man pay? 6 + 12 — 8 + 20 = 30. and 3000 — 30 = 2970, the $\frac{1}{2}$ of it is 1485, the $\frac{1}{3}$ is 980. the $\frac{1}{4}$ = 742 $\frac{1}{2}$; all which added together 5197 $\frac{1}{2}$: 2970 :: 1485 :: 990 :: 1980 :: 742 $\frac{1}{2}$.

20. There are 8 Owners of a Ship, each Man having an equal $\frac{1}{8}$ part, and 3 of them buy out 2 of them for 675 *l.* whereof one of them pay 300 *l.* the other 200 *l.* and the third 275 *l.* for Fraught, there is due 986 *l.* How shall it be divided amongst these 8 Owners? $\frac{1}{8}$ of 986 *l.* is 123 *l.* $\frac{1}{4}$ and $\frac{2}{8}$ is 246, $\frac{1}{2}$. Then say 675 *l.* : 246 :: 300 :: 200 :: 175, the Quotients must be added to each Mans $\frac{1}{8}$ which they have already.

21. A

21. A Farmer hath Wheat at 2 *s.* 8 *d.* the Buſhel, and Rye at 2 *s.* the Buſhel, and would mingle the ſame together by equal portions, that is, as much of the one as of the other, what will be the price of one Buſhel of that mixture? 2 *s.* + 2 *s.* 8 *d.* = 4 *s.* 8 *d.* the $\frac{1}{2}$ thereof is 2 *s.* 4 *d.* the Anſwer.

22. A perſon has 27 *l.* of ſome Commodity at 6 *s.* *per* pound, 15 pound at 2 *s.* 6 *d.* and 10 pound at 2 *s.* 2 *d.* what will the price of one pound of that mixture coſt? Anſwer 51 *d.* $\frac{1}{16}$. For 27 + 15 + 10 = 52. and 27 X 6 = 162 and 15 X 2 $\frac{1}{2}$ = 37 *s.* 6 *d.* and 10 X 2 $\frac{1}{6}$ = 21 *s.* 8 *d.* and 162 *s.* + 37 *s.* 6 *d.* + 21 *s.* 8 *d.* = 221 *s.* 2 *d.* or 2654 *d.* Then as 52 : 2654 :: 1 : 51 $\frac{1}{16}$. The Anſwer.

23. How many Quarts of Sherry at 9 *d.* and Malago at 6 *d.* *per* Quart muſt I mix with a 100 Quarts of Canary, at 12 *d.* *per* Quart, to make a mixture of Liquor at 10 *d.* *per* Quart?

10	12	41	5 Canary	5 : 2 :: 100.	
	9	4	2 Sherry	5 : 2 :: 100.	
	6	4	2 Malago		

Anſwer 40 Quarts of each.

These

by unity? 2519 Is one number that will do it, as may be prov'd by this Example.

2519		
279	(8	
314	(7	Quotients.
356	(6	
419	(5	
403	(4	
629	(3	
839	(2	
259	(1	Remainders.

28. Two numbers are given in one summ, which make unity or (1.) these numbers being divided one by the other the Quotient is (11.) What are those numbers? They are $\frac{1}{12}$ and $\frac{11}{12} = \frac{12}{12}$ *viz.* 1. and the Quotient 11.

29. To find a number which being multiplied into a number given, shall produce a Product equal to the Quotient of 2 numbers, being divided one by the other. Suppose the number 24 divided by 4 the Quotient is 6. Now to find a number, which being multiplied by 24, which shall also produce 6 in the Product, equal to the aforesaid Quotient. Here you are to divide a unite (with Cyphers added first thereunto,

as

as many as are convenient) by your Diviſor given, and that produces a Quotient, which multiplied by your dividend given, produces a Product equal to the Quotient given, abating the decimal parts, as is uſual in Decimal Arithmetick: So if you divide 1,00 by 4, the Quotient is .25 parts (*viz.* leſs than unity) becauſe the (4) ſtands under (0) in the Diviſion, therefore 2 parts, or cyphers, muſt be cut off from the Product of 24. by .25 *viz.* 6 (00, and thus the Product is equal to the aforeſaid Quotient.

As for Example.

(1)

4) 24 (6.
24
00

(2)

4) 100 (.25
8
20
20
00

(3)

24
.25
120
48
6.00

The

The foundation of this is to be ſeen in working by the *Logarithm's*, *viz.* taking the *Arithmetical Complement* of a *Logarithm* of the firſt number in the Golden Rule, and then Addition performs the work; which is Multiplication in thoſe numbers, and Diviſion (which is ſubſtraction in *Logarithms*) is wholly omitted.

30. A Goldſmith hath three Cups mark'd *A B C*, which hath one Cover, and weighed 57 Ounces all together. They are in ſuch proportion, that if the Cover be put upon *B* it weighs twice as much as *A*. If the Cover be put upon *A* it weighs thrice as much as *B*. If the Cover be put upon *C* it weighs 3 times as much as *A*, or 4 times as much as *B*. Now I demand what the weight is of each Cup and Cover?

I Anſwer, *A* weighs 12 Ounces, *B* 9 Ounces, and *C* 21 Ounces, but the Cover only 15 Ounces, which all together make up 57 Ounces, as before.

This Queſtion is wrought by double Poſition.

A 12. + 15 = 27. *viz.* 3 *B*'s.
B 9. + 15 = 24. *viz.* 2 *A*'s.
C 21. + 15 = 36. *viz.* 3 *A*'s, or 4 *B*'s.

31. If 12 Yards of Cloth coſt 12 *l.* 16 *s.* what number of Yards did I buy, when the number of Yards and Shillings are 1000. Anſwer 44 $\frac{5}{7}$ Yards; find the Quotient of 1000 divided by 22 $\frac{1}{2}$, and the Queſtion is Anſwer'd.

32. Three Merchants *A. B. C.* enter into Company, *A.* puts in 350 *l.* more than *B.* and *B.* and *C.* together put in 840 *l.* their common gain is 660 *l.* whereof *C.* his ſhare is 210 *l.* What diſtinct ſtock did each Merchant put into the Bank, and what particular ſhare in the common gain muſt *A. B.* receive?

I Anſwer, *A.* brought into the ſtock 700 *l.* *B.* 350 *l.* and *C.* 490 *l.* Laſtly, *A*'s ſhare is 300 *l.* and *B*'s 150 *l.*

33. There is a Rectangle plain Triangle, having the Area thereof given 1728 ſquare Inches; Alſo the ſumm of the Hypotenuſal and Perpendicular 134. 53321, to find the ſides apart. I Anſwer, the Perpendicular is 48, and the Baſe 72; then the Hypotenuſal will be 86. 53321.

34. Three men divide a ſumm, ſuppoſe them *A. B. C.* *A.* gives both the other as much as they had before, *B.* then gives both the

the other as much as now they have, and *C.* doth the like; at last each Man had 8. The Question is, how much had each Man at first? I Answer *A.* had 13. *B.* 7. and *C.* 4.

35. There is a Wall which contains 18225 Cubical Feet, the height is 5 times the bredth or thickness; the length 8 times the heighth; what is the bredth, *&c.?* Answer $4\frac{1}{5}$ Foot is the bredth, the heighth $22\frac{1}{5}$ Foot, and the length 180 Feet.

36. *A. B.* and *C.* have each of them money *A*'s money with half of *B*'s and *C*'s is = 30 *l.* *B*'s money with $\frac{1}{3}$ of *A*'s and *C*'s = 30 *l.* *C*'s money with $\frac{1}{4}$ of *A*'s and *B*'s = 30 *l.* The Question is, how much money had each person? I Answer, *A.* hath 8 *l.* $\frac{14}{17}$ *B.* 19 *l.* $\frac{7}{17}$, and *C.* hath 22 *l.* $\frac{15}{17}$.

37. Suppose a *Cestern* hath 3 Cocks mark'd *A. B. C.* which are in such proportion, one to the other, that if *A.* be set open, it will fill the *Cestern* in $\frac{1}{2}$ the time that *B.* and *C.* will, being set open together; and if *B.* be set open, it will be filling the *Cestern* 5 times as long as *A.* and *C.* will be, being set open together; and if *C.* be set open, 'twill be 10 hours longer time than *A.* will be in filling the *Cestern*. The Question is, how

long each Cock alone (being ſet open) will be filling the Ceſtern; and if all the Cocks be ſet open together, in what time may this Ceſtern be fill'd? Anſwer. *A.* will be 3 hours $\frac{1}{3}$ filling the Ceſtern alone, *B.* 13 hours $\frac{1}{3}$ filling it alone, and *C.* 13 hours $\frac{1}{3}$. But *A*, *B*, *C.* being open all together, it will be fill'd in 2 hours $\frac{2}{3}$. Wrought by falſe Poſition.

38. There is a Field in the Form of a perfect Square, whereof the Square Perches in the Area, being multiplied by the *Diagonal* Line, produces $527852\frac{40792}{100000}$. What is the ſide of this Field? Anſwer 72 Perches.

The RULE.

Of half the Square of the given Product, the ſixth power thereof, or the ſquar'd Cubick Root, is equal to the ſide ſought.

This will prove a difficult Queſtion unto ſuch as are unacquainted with the excellency and facility of the *Logarithm's*, in the extraction of Roots; as alſo in *Multiplications* and *Diviſions*, as may partly appear in the proof of the Queſtion.

Example.

Example.

The Log. of 527852,40192 = 5,7225125.

The same again for the □ of the number given, or multiply the Log. by 2. } 5, 7225125. / 11. 4450250.

The Logar. of the □ 2786281582 12. 71322.

This Logar. divided by 6 the Quotient will be thus, *viz.* 11,1439950. 1393140791 06. = 3566

It's Semi-Quadrant.

1, 8573325. Responsio 72 Perches.

The Proof.

1, 8573325 = 72 Perches in the side of the Field.

3, 7146650 = 5184 □ Perch in the Field.

2

4, 0156950 = 10368 square of the Diagonals.

2, 0078475 = 101. 82338 Perch the Diagonal.

5, 7225125 = 527852. 40192. as it was at first, *viz.* the square Perches in the *Area*, and the *Diagonum* added together.

39. There is a Field in the direct form of an Æquilateral Triangle, one side (and consequently each) being 72 Perches; How many Acres of Land is the Area of this Field? Answer 14 Acres and 4 Perches.

The RULE.

Multiply the ſquare of half the ſide, by the Square Root of 3. *viz.* 1.732050807. and that Product is equal to the Area in ſquare Perches, which divided by the number of ſquare Perches in an Acre, or rather by [–.00625] Quotes the Area as aforeſaid.

40. If a Clock hath 2 Indices, whereof one makes 2 revolutions in a Day natural, *viz.* 24 hours, and the other makes only one revolution in 30 ſuch days: Now if theſe Indices be ſet at one and the ſame point upon the Dial-Plate, do begin their Motion. How many hours muſt paſs before they both come again to point at one and the ſame point as before?

In a Day natural 24 hours.

30 X

24

296

2 X

1392

As 1392 Hours to 24 Hours, ſo 720 Hours to 12 Hours.

The Anſwer.

Here

Here follows seven Questions as exercise and recreation for an Accomptant.

1. THree Merchants, *A. B. C.* stand severally indebted to the French King in great summs of money, but the Account-Book being imbezill'd, neither their total Debt, or the distinct Debt of any one of them can be charged, the Accomptants do only remember and depose, that the Debt of *A*, together with that of *B*, is 127009 *l.* 15 *s.* 9 *d.* of *B* and *C* together 99007 *l.* 19 *s.* 0. and of *A* and *C* 118010 *l.* 13 *s.* 5 *d.* How much in particular doth each Merchant owe?

2. Two persons stand severally indebted to the City-stock in great summs of money, but the Account-Books being imbezill'd, their particular charge cannot thence be given, only the Accomptants do depose that *A* his Debt is 3 and $\frac{1}{2}$ times as much as that of *B*, and that *B* owes less than *A* by 27161 *l.* 5 *s.* 4 *d.* $\frac{1}{2}$ what is *B* his distinct Debt?

3. *A* took up of *B* 1000 *l.* conditioning in liew thereof to settle upon him a clear Rent of 50 *l.* *per* Quarter, till he be reimburs'd his Principal with Compound Interest, after the rate of 6 *per Cent.* How

many full Quarters muſt *B* receive, and what ought his laſt Receit to be?

4. Two perſons, *A* and *B.* are ſeverally indebted to the Kings Majeſty in conſiderable ſumms of money together, amounting to 90001 *l.* 13 *s.* 5 *d.* whereof it is known that *A* owes more than *B* 9990 *l.* 6 *s.* 7 *d* $\frac{1}{2}$. But the Audit-Books being loſt, the Queſtion is, what the diſtinct Debt of *A* is. This is eaſily perform'd only by ſubſtraction.

5. *A.* wants 1000 *l.* ready money, *B.* will furniſh him, and forbear principal and intereſt for 9 years $\frac{3}{4}$, upon condition of 2000 *l.* ſecur'd to be then paid; what rate of compound Intereſt *per Cent. per Annum* doth *B.* demand?

6. Two Shop-Keepers are ſeverally Indebted to a Merchant in great ſumms of money amounting together to 2900 *l.* 19 *s.* 4 *d.* whereof it is known that *B.* owes 16 *s.* as often as *A.* 3 *s.* 4 *d.* but the Account-Book being loſt, the Merchant deſires to know the diſtinct Debt of *A*?

7. Two Merchants, *viz. A.* and *B.* enter into Company, their common ſtock is 12000 *l.* wherewith they gain'd 3000 *l.*

A. his

A. his money remain'd in Company 4 Months, and that of *B.* 8 Months, *A.* receiv'd for stock and gain 5000 *l.* What distinct stock did each man bring into Company?

CHAP. XXII.

Of Measuring both Plains and Solids, various proportions perform'd by the Golden Rule, &c.

1. IN Board Measure. As 1 Inch is to the breadth in Inches, so is the length in Inches to the Content in Inches.

2. As 144. is to the breadth in Inches, so is the length in Inches to the Content in Feet.

3. As one Foot is to the breadth in Feet, so is the length in Feet to the Content in Feet.

4. As 12 Inches to the breadth in Inches, so the length in Feet to the Content in Feet.

5. As the breadth in Inches to 144, so is 1 Foot to the length of a Foot in Inch-Measure.

6. As the breadth in Foot Measure is to 1 Foot, so is 1 Foot to the length of a Foot in Foot-Measure.

7. The mean proportion between the length and breadth of an oblong Superficies, giveth the side of the Square equal thereunto.

Of Measuring of Land.

1. AS 1 Perch to the breadth in Perches, so is the length in Perches to the Content in Square Perches.

2. As 160 to the breadth in Perches, so is the length in Perches to the Content in ☐ Acres.

3. As 40 (if a 2 Pole Chain) or as 17. 778 if a 3 Pole Chain, or as 10 if a 4 Pole Chain to the breadth in Chains, so is the length in Chains to the Content in Acres.

(1) (2) (3) (4)

4. As 320, or 80, or 35. 556, or 20 (being the precedent Terms doubled) to the Perpendicular of a Triangle, so is the length of the Base to the Content in Acres.

5. As the length of a square piece of Ground is to 160 (if a Pole) to 40, if a 2 Pole Chain, to 17. 778 (if a 3 Pole Chain) or to 10 (if a four Pole Chain) so is the number of Acres requir'd to the breadth thereof.

6. As

6. As the length of 1, or divers Acres measur'd out in a Square, or an Oblong square piece of ground is to the number of Poles irregularly at the side or ends thereof, so is 1 to the breadth of a slip of the said Acre, or Acres, which being taken out, the remainder with the said Poles are the Acre or Acres requir'd.

7. As the Content of a Rectilineal Triangle, either Rectangular or Oblique Angular is to the length of the side opposite to the Angle from which the line is to be drawn, so is any part of the Content of the said Triangle requir'd to part of the said side, to which from the opposite Angle, a line being drawn, giveth the part of the Content requir'd.

8. If a piece of ground be measured according to one kind of Perch, to find the Content according to another. It follows, as the length of the second is to the length of the first Perch, so is the Content in Acres to a fourth number, and that fourth to the Content in Acres requir'd. *These proportions are most easily exemplyfied by the Rules given in the Golden Rule before in its proper place*, &c.

Of

Of Timber Measure, viz. Square Solids, Rectangular and perfect Cylinders.

1. AS 1 is to the breadth, so is the depth to the Content of the Base of a Rectangular Square Solid.

2. The Content of the Base of a Cylinder being a Circle may be found thus, *viz.* As 1 to the Square of the Circumference so is .079578 to the Content thereof requir'd.

3. Now as the Content of the Base of either of the 2 solids aforesaid in Foot Measure is to 1, so is 1, to the length of a Foot solid in Foot measure.

4. As the Content of the Base in Inches is to 1728, (the solid Inches in a square Foot of Timber) so is 1. to the length of a Foot solid in Inch measure.

5. As 1. to the Content of the Base in Inches, so is the length in Inches to the solid Content in Inches.

6. As 1728 is to the Content of the Base in Inches, so is the length in Inches to the Content in Feet.

7. As 1. to the Content of the Base in Foot measure, so is the length in Feet to the Content in Feet.

8. As 144 is to the Content of the Base in Inches,

Inches, so is the length in Feet to the Content in Feet.

9. As the Diameter of a Cylinder in Inches is to 46.90, so is 1. to a fourth, and that fourth number to the length of a Foot solid in Inches (the term or number for Foot measure is 1|.128.)

10. As the Circumference in Inches to 147, 36 so is 1 to a fourth, and that fourth number to the length of a Foot solid in Inch measure (the term for Foot measure in this case is 3.545.)

11. As 13. 54 to the Diameter in Inches, so is the length in Feet to a fourth number, and that fourth number to the Content in Feet.

42. 54 Is the Term for the Circumference.

Of Cylindrical Solids, and Squar'd, having the two Bases unequal, as most Timber is.

1. MUltiply the greater Base by the lesser, and extract the *Square-Root* of the Product, then add this Root and the 2 Bases together, and multiply their summ by $\frac{1}{3}$ part of the length of the Solid, that last Product is the solid Content of the Taper piece of Timber requir'd.

Here note, that the vulgar manner which Carpenters use in measuring Taper Timber, is not true; for they measure it in the very middle, and taking the Content of the Base thereof, do multiply it into the length of the Piece, which is always less than the true Content, viz. in a Piece of squared Timber by a Parallelepipedon, under half the differences of the breadth and thickness at both ends, and a third part of the whole length. But in a Piece of a Round Tapering Timber by a Cylinder, the Diameter of whose Base is equal to half the difference of the Diameters of the 2 Bases, and the length is $\frac{1}{3}$ part of the whole length.

2. A Compleat Pyramide having but one Base, and that right lin'd, or a Cone, and the Base Circular; If you multiply the *Area* of the Base into $\frac{1}{3}$ part of the Altitude, the Product is the solid Content requir'd.

A Table shewing how much in length will make a solid Foot of Timber, the side of the Square being known.

Side	Len. of a Foot.				Side	Len. of a Foot.			
Inch.	F.	In.	10	P.	Inch	F.	In.	10	P.
1	144	0	0		19	0	4	8	
2	36	0	0		20	0	4	3	
3	16	0	0		21	0	3	9	
4	9	0	0		22	0	3	6	
5	5	9	2		23	0	3	3	
6	4	0	0		24	0	3	0	
7	2	11	2		25	0	2	8	
8	2	3	0		26	0	2	6	
9	1	9	3		27	0	2	4	
10	1	3	3		28	0	2	2	
11	1	2	3		29	0	2	1	
12	1	0	0		30	0	1	9	
13	0	10	2		31	0	1	8	
14	0	8	8		32	0	1	7	
15	0	7	7		33	0	1	6	
16	0	6	7		34	0	1	5	
17	0	6	0		35	0	1	4	
18	0	5	3		36	0	1	3	

The use of the Table.

If your Timber have the sides equal then find the depth of one side in the Table, (under the Title side) and against it you have the length of a Foot; Thus, if the side of the Square be 9 Inches, then 1 Foot, 9 Inches, and 3 tenth parts of an Inch, doth make a Foot; And if the side be 22 Inches, then 3 Inches and 6 tenth parts of an Inch will make a Foot solid: But if the sides of your Timber be unequal, that is, one deeper than the other, you must find the true Square, thus, Multiply the one side by the other, and out of the Product extract the Square Root, or by your line of numbers, thus, divide the distance upon the line, between the two unequal sides, into two equal parts, and the Compasse will rest upon the true Square, with which number you must enter the Table.

A Table

A Table shewing how many Inches in length will make a Foot of any round piece of Timber, whose compass is known.

Com.	Len. of a Foot.		Com.	Len. of a Foot.		Com.	Len. of a Foot.	
Inc.	Inc.	100 P.	Inc.	Inc.	100 P.	Inc.	Inc.	100 P.
20	54	29	47	9	83	74	3	97
21	49	33	48	9	42	75	3	86
22	44	86	49	9	04	76	3	76
23	40	90	50	8	69	77	3	66
24	37	69	51	8	35	78	3	57
25	34	74	52	8	03	79	3	48
26	32	12	53	7	73	80	3	39
27	29	79	54	7	42	81	3	01
28	27	70	55	7	18	82	3	23
29	25	82	56	6	52	83	3	15
30	24	13	57	6	68	84	3	08
31	22	60	58	6	45	85	3	01
32	21	21	59	6	24	86	2	94
33	19	92	60	6	03	87	2	87
34	18	78	61	5	84	88	2	80
35	17	74	62	5	65	89	2	74
36	16	76	63	5	47	90	2	68
37	15	86	64	5	30	91	2	62
38	15	04	65	5	14	92	2	57
39	14	28	66	4	98	93	2	51
40	13	57	67	4	84	94	2	46
41	12	92	68	4	70	95	2	41
42	12	31	69	4	56	96	2	36
43	11	74	70	4	43	97	2	31
44	11	31	71	4	31	98	2	26
45	10	72	72	4	20	99	2	22
46	10	26	73	4	08	100	2	17

The use of the Table.

Find the compass of the tree in the first, third or fifth Column, and against it you have the length of a Foot. Thus, the compass being 20 Inches, the length of a Foot must be 24 Inches and 13 hundred parts of an Inch. If the compass be 60 Inches, then 6 Inches and 7 hundred parts will be a Foot. If 85, then 8 Inches 1 part is a Foot.

Simple

Simple INTEREST *direct, from Quarter to Quarter, at VI. per Cent. per Annum.*

Prin.	1 Quarter.				2 Quarter.				3 Quarter.				4 Quarter.			
Poun	L.	S.	D.	P.	L.	S.	D.	P.	L.	S.	D	P	L.	S.	D.	P.
1000	29	16	04	20	60	03	03	4[illegible]	90	01	07	72	120	00	00	00
1000	14	19	02	14	30	01	07	73	45	00	09	8[illegible]	60	00	00	00
500	07	09	07	07	15	00	09	80	22	10	04	92	30	00	00	00
400	05	19	08	05	12	00	07	89	18	00	03	95	24	00	00	00
300	04	09	09	0	9	00	05	92	13	10	02	96	18	00	00	00
200	02	19	10	03	06	00	03	95	09	00	01	97	12	00	00	00
100	01	09	11	01	03	00	01	97	04	10	00	95	06	00	00	00
90	01	06	11	11	02	14	01	7[illegible]	04	01	00	85	05	08	00	00
80	01	03	11	21	02	08	01	58	03	12	00	79	04	16	00	00
70	01	00	11	31	01	02	01	38	03	03	00	69	04	04	00	00
60	00	17	11	41	01	16	01	18	02	14	00	55	03	12	00	00
50	00	14	11	51	01	10	00	95	02	05	00	49	03	00	00	00
40	0	11	11	6[illegible]	01	04	00	75	01	06	00	35	02	08	00	00
30	00	08	11	70	00	18	00	59	01	07	00	29	01	16	00	00
20	00	05	11	8[illegible]	00	12	00	39	00	18	00	20	01	04	00	00
10	00	02	11	91	00	06	00	20	00	09	00	10	00	12	00	00
9	00	02	06	31	00	05	04	9[illegible]	00	08	01	29	00	10	03	60
8	00	02	04	72	00	04	09	7[illegible]	00	07	02	48	00	09	07	20
7	00	02	01	13	00	04	02	54	00	06	03	67	00	08	04	80
6	00	01	09	54	00	03	07	32	00	05	04	86	00	07	02	40
5	00	01	05	95	00	03	00	10	00	04	06	0[illegible]	00	06	00	00
4	00	01	02	3[illegible]	00	02	04	88	00	03	07	24	00	04	09	60
3	00	00	10	77	00	01	09	66	00	02	08	43	00	03	07	20
2	00	00	07	18	00	01	02	44	00	01	09	62	00	02	04	80
1	00	00	03	5[illegible]	00	00	07	22	00	00	10	81	00	01	02	40
Shil.																
10	00	00	01	79	00	00	03	61	00	00	05	41	00	00	07	20
9	00	00	01	61	00	00	03	25	00	00	04	86	00	00	06	48
8	00	00	01	43	00	00	02	85	00	00	04	32	00	00	05	76
7	00	00	01	2[illegible]	00	00	02	53	00	00	03	78	00	00	05	04
6	00	00	01	0[illegible]	00	00	02	17	00	00	03	42	00	00	04	32
5	00	00	00	9[illegible]	00	00	01	80	00	00	02	70	00	00	03	60
4	00	00	00	72	00	00	01	44	00	00	02	1[illegible]	00	00	02	88
3	00	00	00	54	00	00	01	0[illegible]	00	00	01	62	00	00	01	16
2	00	00	00	3[illegible]	00	00	00	72	00	00	01	08	00	00	01	44
1	00	00	00	1[illegible]	00	00	00	3[illegible]	00	00	00	54	00	00	00	72

A Decimal

A Decimal Table for the Solution of all Questions of Interest and Annuities, at 6 per Cent. per Annum.

Yea	1 Part.	2 Part.	3 Part.	4 Part.	5 Part.	6 Part.
1	10600	10000	10000	9434	9434	10600
2	11236	20600	4854	8900	18334	5454
3	11910	31836	3141	8396	26730	3741
4	12625	43746	2286	7926	34651	2886
5	13382	56371	1774	7472	42124	2374
6	14188	69753	1434	7047	49173	2034
7	15036	83938	1191	6651	55824	1791
8	15939	98975	1010	6274	62098	1610
9	16895	103422	969	5919	68017	1470
10	17908	131808	759	5584	73601	1359
11	18983	149716	668	5268	78869	1268
12	20122	168699	593	4970	83838	1193
13	21329	188821	530	4688	88527	1130
14	22609	210151	476	4423	92950	1076
15	23966	232760	430	4173	97122	1030
16	25404	256725	390	3939	101059	990
17	26928	282189	355	3714	124773	954
18	28544	309048	324	3503	108276	924
19	30256	337600	295	3305	111581	896
20	32072	367856	272	3118	114699	872
21	33996	399927	250	2942	117641	850
22	36036	434567	230	2775	120416	831
23	38198	469958	212	2618	123034	813
24	40490	508156	197	2470	125504	797
25	42919	548645	182	2330	127834	782
26	45494	591564	169	2198	130032	869
27	48224	637058	157	2074	132105	757
28	51117	685281	146	1956	134062	746
29	54184	736398	136	1846	135907	736
30	57385	790582	126	1741	137648	726
31	60882	848017	118	1643	139291	718

The Use of the foregoing Tables.

SEek the Summ for which you would know the Interest, in the side of the first Table, and the Time in the head thereof, and then at the Angle of meeting you have your desire.

For Example.

If you desire to know the Interest due for 10 *l.* for a Quarter of a Year, you have it in the first Column, being 2 *s.* 11 *d.* and the 91 part of an hundred; for half a year 6 *s.* 0 *d.* and the 20 part of an hundred: for 3 Quarters, 9 *s.* 0 *d.* and the 10 part of one hundred: and for one Year, 12 *s.* In like manner you may find the Interest for 400 *l.* for a quarter to be 5 *l.* 19 *s.* 8 *d.* 5 *p.* For half a year, 12 *l.* 0 *s.* 7 *d.* 89 *p.* For 3 quarters, 18 *l.* 0 *s.* 32 *d.* 95 *p.* And for a year 24 pounds: But when your Summ for which you would know the Interest, consisteth of one hundred hundreds, ten tens, &c. you must take their respective Interests out of the Table, and add them all together: *For Example:* Suppose I would know the Interest due for 347 *l.* for half a year, in the upper part of the Table under 2 quarters, against 300, I have 9 *l.* 0 *s.* 5 *d.* 92 *p.*

9	0	5	92	
1	4	0	79	
0	4	2	54	
10	8	9	25	

over

over against 40, 1 *l.* 4 *s.* 0 *d.* 79 *parts*, and against 7 *l.* 4 *s.* 2 *d.* 54 *parts*; which being added together, maketh 10 pounds, 8 shil. 9 pence, and 25 hundred parts of a penny, as you may see in the Margin.

The Use of the second Table.

THE Table consisteth of 6 Parts or Columns; the first whereof is to shew what any Summ will amount unto, at the end of any Years under 31, accompting Interest upon Interest at *6 per Cent.* The second Part is to shew what any Annuity, being forborn from year to year, will amount to at the end of any year under 31. The third part is to shew what yearly payment is equal to any Summ due at the end of any years under 31.

The fourth part is to shew what any Summ due at the end of any years under 31, is worth in ready money.

The fifth part sheweth what any Annuity, to continue for any years under 31, is worth in ready money.

The sixth part of the Table is to shew what Annuity any summ will buy, to continue for any number of years under 31.

When a Question is propounded, consider unto which part of the Table it doth appertain, and take out the numbers in that part over against the Years expressed in the question,

stion, and multiply them by the Summ of money expressed in the question; and from the Product cut off four figures toward the right hand, and then those to the left hand are pounds: Multiply the figures cut off to the right hand, by 20, and cut off four figures from the Product, as before, and to the left hand you have Shillings: Again, multiply the figures last cut off by 12, and cut off four figures as before, and you have to the left hand pence, *&c.*

An Example of the first Part.

If 50 l. *be put out at Interest for* 15 *years at* 6 per Cent. *what Summ will it amount to at the end of that time?* Over against 15 in the first part, you have 23966, which multiplied by 50, (the number of pounds in the Question) the Product will be 119|8300, from which cut off four figures to the right hand, and you have to the left hand 119 *l.* multiply the 8300, to the right hand by 20, and from the Product being 16|6000 cut off four figures, and you have 16 *s.* multiply the 6000 cut off to the right by 12, and you have 7|2000. *viz.* 7 *d.* the whole Answer to the Question, being 119 *l.* 16 *s.* 7 *d.*

An Example of the second Part.

If 40 *pound a year be forborn seven years, what will it amount to at the end of those years?* In the second part against 7 years, you have 83938,

83938, which being multiplied as in th
first, you will have for Answer to the Questi
on 335 *l.* and 15 *s.*

An Example of the third Part.

There is 80 *pounds to be paid at the end*
10 *years, the party who is to pay this* 80 *l.*
willing to make over certain Lands for 10 *year*
to make satisfaction, and is desirous to know wh
yearly Rent will satisfie the Debt then due, allow
ing Interest at 6 per Cent. per Annum.

In the third part against 10 years, you ha
759, which multiplied by 80, the pounds i
the Question, your first operation will b
6|0720, your second 1|4400, and you
third 5|2800; the Answer to the questio
being 6 pounds, 1 shilling, and 5 pence.

An Example of the fourth Part.

There is certain Lands, which at the tak
possession are worth 58 *l. I desire to know wh*
they are worth 8 *years in Reversion, allow*
ing for the forbearance of the money at 6 *p*
Cent.?

Over against 8 in the fourth part I ha
6274, which being multiplied by 58,
Sum in the Question, the Product is 36|389
the second operation is 7|7840. and the la
9|4080. *viz.* 36 *l.* 7 *s.* and 9 *d.* being th
Answer to the Question.

An Example of the fifth Part.

Suppose an Extent on certain Lands for

Paym

yment of 60 *pounds in* 20 *years*, viz. 3 *l.* er ann. *the Owner of this Land is willing to ſcharge this Extent with ready money, the queſtion is what Summ will diſcharge the ſame?*

In the fifth part againſt 20 years, you ave 114699, which being multiplied by 3, e pounds in the Extent, and divided by 0000, as before, the Anſwer to the queſtion will be 34 pounds, 8 ſhillings, and 2 ence.

An Example of the ſixth Part.

There is 104 *pounds to be beſtowed upon an Annuity for to continue* 14 *years, I deſire to know what Annuity it will buy, to continue ſo long,* viz. 14 *years.*

In the laſt part of the Table againſt 14 ears, I have 1076. which multiplied by 04. maketh 11|1904, the firſt operation, nd 3|8080 for the ſecond, and 9|6960 or the laſt: the Anſwer to the queſtion be- ng 11 *l.* 3 *s.* and 10 *d.*

Note, That you may eſtimate the value of he 4 Figures cut off thus, *viz.* The firſt igure to the left hand you are to account ouble ſhillings; the ſecond Figure, if it be bove 5, ſubduct 5 from it, and account for hat 5 one ſhilling more, and the remainder or 10 times ſo many Farthings; For you muſt note, that all numbers in the ſecond nd third place, not exceeding 24, are a

just number of Farthings, if they exceed 2 [illegible] cast away 1, and the remainder is the ju[illegible] number of Farthings sought, and all Figure[illegible] beyond the third place (if they [illegible]ere a[illegible] nines) are but parts of Farthings.

As for instance in the last Exam[illegible]e of th[illegible] sixth part of the second Table, the numbe[illegible] came forth 11 | 1904. *viz.* 11 *l.* 190[illegible] Now this Decimal Fraction may be thus esti[illegible]mated, *viz.* for 1 I account 2 *s.* then take [illegible] makes out of the 9 for another Shilling, whic[illegible] 11 *l.* 3 *s.* then the 4 that remains are 4[illegible] Farthings, which is 10 *d*, the next is a Cy[illegible]pher, had it been a figure of 9 it had bee[illegible] but part of a Farthing, a thing inconsidera[illegible]ble; so that by this method you find the De[illegible]cimal 1904. to be 3 *s.* 10 *d.* as before th[illegible] other way by Multiplication. Note, that [illegible] the second Figure in the Decimal be under [illegible] 1, 2, 3, or 4, then it stands for [illegible] times so many Farthings as the figure co[illegible]tains, like as those above 5 do; and thus t[illegible] Rule is made plain to the meanest capacit[illegible] and will become very easy by Practice.

A[illegible] and *Sciences Mathematical*, Profess'd and Taught [illegible] COLEY, at his House in *Baldwins-Co*[illegible] the *Old Hole* in the Wall in *Baldwins-G*[illegible] [illegible]h, Geometry, Trigonometry, Navi[illegible] [illegible] Use of the Globes, and other Mathe[illegible] [illegible] Also Dyalling, Surveying, Gage[illegible] [illegible] Art of *Astrology* in all its Parts.

FINIS.